SCIENCE

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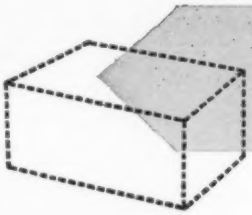

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23 September 1955, Volume 122, Number 3169

SCIENCE

Help Wanted

It is predicted that one-third of the graduates who were recruited from the nation's 1857 colleges in 1955 will change jobs within a year. Turnover will cost employers approximately $400 million. If students had been "work-oriented" before graduation, the personal and financial losses probably would be considerably less.

College enrollment will double in 15 years. The Ford Foundation reports that 200,000 additional college teachers must be recruited by 1970. Much has been said about monetary needs. Less recognition has been given to guidance and counseling problems that will confront adminstrators, teachers, and students in the future.

Who does most of the student counseling on the typical college campus? Professors, particularly psychologists, and educationists are active in liberal arts colleges. They aid students in clarifying their thinking concerning personal problems. But, too frequently, such counselors are woefully lacking in industrial experience, which would be helpful when vocational choices are under consideration. Counseling is handled more realistically in colleges of engineering where placement officers (who maintain close contacts with industry) also function as student advisers. For example, 85 percent of the Cornell engineering graduates remain with their first employers longer than 1 year. This is a direct consequence of a "work-oriented" program that is correlated with industry's needs.

College administrators have found it desirable to centralize certain functions. They have appointed deans of instruction, comptrollers, and superintendents of grounds and have given them responsibility for well-defined activities. But everybody is a personnel expert. Anyone not only can do, but does, student counseling. Coordination frequently is lacking between the offices of the director of admissions, registrar, dean of men, dean of women, chaplain, and placement officer. In former days, when everyone on the campus presumably knew everyone else, the laissez-faire system worked in a fashion. But that day is gone.

The function of a college is to serve the best interests of its students. It now does a good job of housing and teaching them. The next major task is to help students use their abilities in ways that will be personally satisfying and also useful to the nation. Better counseling should reduce college failures and improve postcollege adjustment. Coordination, rather than expansion, of existing personnel facilities is needed. Industry has taken 40 years to coordinate its employee functions under vice presidents in charge of personnel. College officials may find it necessary to put their houses in order in a tenth of that time.The close cooperation that now exists between colleges and industry is expressing itself in the form of scholarships, grants-in-aid, and gifts of equipment. An exchange of "know-how" in the field of human relations should be of mutual benefit.

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Properdin System and Immunity

II. Interaction of the Properdin System with Polysaccharides

Louis Pillemer, Melvin D. Schoenberg, Livia Blum, Leona Wurz

Properdin (*1, 2*) in conjunction with Mg^{++} and serum cofactors resembling the components of complement (C′) kills or inactivates certain bacteria (*3*) and viruses (*4*) and participates in the lysis of abnormal red cells (*5*). The observation that zymosan (*6*), an insoluble carbohydrate complex derived from yeast cell walls, combines with the properdin at 17° to 37°C in the presence of C′ and Mg^{++} led to the discovery and isolation of properdin (*1*). The resulting properdin-zymosan complex (PZ) inactivates the third component of complement (C′3) at 37°C (*1*). This forms the basis for the assay of properdin. Present evidence, although not conclusive, indicates that the mechanisms of interaction of properdin with zymosan and of properdin with bacteria and other agents are similar. However, C′3 does not appear to be inactivated in some of these reactions.

Previous work (*7, 8*) on the parenteral administration of zymosan and *E. coli* cell walls into laboratory animals demonstrated that zymosan and the cell walls interact with properdin *in vivo* and alter the serum properdin levels of the test animals. Shortly after the injection of these materials, the serum properdin titers fall to a low level but may return to levels considerably above normal within a few days. There appears to be a relationship between these changes in serum properdin titers *in vivo* and the susceptibility and resistance to experimental infection (*7–9*).

In order to obtain a better understanding of the full importance and the mechanics of the properdin system, a search was made for compounds that interact with the properdin system both *in vitro* and *in vivo* (*10*). It will be seen in the following discussion that zymosan is not unique in its ability to form a complex with properdin *in vitro* and to alter properdin levels *in vivo* but that this ability is shared with many other high molecular weight polysaccharides or polysaccharide complexes and cell walls of many bacteria.

Bacterial Cell Walls and Toxins

The action of various bacterial cell walls (*8, 11*) on the properdin system *in vitro* has been investigated here, and some of the results are summarized in Table 1. It will be seen that cell walls from yeasts and both gram-negative and gram-positive bacteria complex with properdin at temperatures between 15° and 37°C. These complexes are insoluble and can be removed from serum by centrifugation at 4000 rev/min at 1°C in an International refrigerated centrifuge (PR-II). Active properdin can be dissociated from the cell walls in a medium of high ionic strength at slightly alkaline *p*H (*1*). With the exception of *E. coli* B, C′3 is specifically inactivated by the cell walls, suggesting the formation of a cell wall-properdin complex similar to PZ, which is then capable of interacting with C′3.

The action of two purified typhoid endotoxins and diphtherial toxin on the properdin system is presented in Table 1. It will be noticed that purified protein-free endotoxin #282 (O antigen) (*12*) removes properdin from serum but does not inactivate C′3. Partially purified endotoxin #AKD-B-3 also removes properdin that could be eluted from the properdin endotoxin complex in the usual fashion. The partial inactivation of C′3 by this endotoxin may be due to contaminating cell wall constituents. Diphtherial toxin, a classical exotoxin (*13*), does not combine with properdin. It should also be noticed that these toxins are anticomplementary at the levels tested and inactivate other components of C′.

Neutral Polysaccharides

Hestrin and coworkers (*14*) have shown that certain high molecular weight native levans and dextrans have infection-promoting activity when they are injected intravenously into mice that are infected intraperitoneally. From their work it appears that the infection-promoting activity of native levan and dextran is the result of an extraperitoneal interaction between these agents and the host. These experiments suggested the possibility that native levans and dextrans might interact with the properdin system *in vitro* and also alter serum properdin levels *in vivo*. Accordingly, a series of dextrans and levans, various zymosans and several other glucans have been tested. The results are summarized in Table 2, which shows the following.

1) Zymosans vary in their effect on the properdin system. Variations in method of preparation may lead to physical and chemical changes of these materials and cause differences in their activity. Zymosans like FL-l and LE-l are representative of those employed in this laboratory. Small amounts of these zymosans added to serum remove properdin and inactivate C′3. Zymosans like FL-145 do not inactivate C′3 but remove properdin, while IIFD is almost entirely inactive. It is obvious that care must be taken to employ suitable zymosans for studies on the properdin system.

2) Native dextrans showed variations in their ability to interact with the properdin system similar to those mentioned in a preceding paragraph for the zymosans. It will be noted that some dextrans combine with properdin and inactivate C′3, others only combine with properdin, and still others are inactive. However, none of the neutral polysaccharides were anticomplementary. The active compounds are all of high molecular weights. Low molecular weight clinical dextrans are entirely inactive. However, several

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Table 1. Effect of bacterial cell walls, polysaccharides, and toxins on the properdin system in human serum

Sample	Maximal amount added to each milliliter of human serum		Removal or inactivation of properdin (%)	Elution of properdin from P-sample complex	Inactivation of C'3 (%)	Anticomplementary or inactivation of other components of C'
	For removal of properdin (mg)	For inactivation of C'3 (mg)				
Cell walls						
E. coli CV	2	1	> 90	+	100	No
E. coli B	5	5	> 90	+	0	No
Rhodospirillum rubrum	2	5	> 90		100	No
Candida pulcherrima	2	5	> 90	+	100	No
Streptococcus faecalis	2	1	> 90	+	100	Yes
Micrococcus lysodeikticus	2	5	> 90		100	Yes
Bacillus megaterium	2	1	> 90	+	100	Yes
Bacterial toxins						
Typhoid endotoxin #282	1.5	3	> 90		0	Yes
Typhoid endotoxin #AKD-B-3	1.5	3	> 90	+	50	Yes
Diphtherial toxin (purified)	3	3	0		0	Yes
Cell wall polysaccharides						
Pneumococcus IV	3	3	50		75	Yes
Pneumococcus XIV	3	3	70		100	Yes
Pneumococcus VIII	3	3	0		0	Yes
Pertussis	2	5	> 90		0	No
Normal serum control			0		0	

Table 2. Effect of various neutral polysaccharides on the properdin system in human serum

Sample	Maximal amount added to each milliliter of human serum		Removal or inactivation of properdin (%)	Inactivation of C'3 (%)	Type AGU links*, †		
	For removal of properdin (mg)	For inactivation of C'3 (mg)			1,6 (%)	1,4-like (%)	1,3-like (%)
Zymosan LE-I	2	2	> 90	100			
Zymosan FL-I	2	0.5	> 90	100			
Zymosan FL-145	2	10	> 90	0			
Zymosan II-D	5	10	20	0			
Glucan (yeast)	5	5	> 90	0			
Glucan (Laminarin)	3	3	> 90	95			
Mannan (yeast)	5	5	0	0			
Clinical dextrans‡							
Cutter (M-1 Lot No. 5-8783B)	20	20	0	0			
Benger (Batch No. 2354)	20	20	0	0			
Glaxo (Batch No. 54/056)	20	20	0	0			
Native dextrans							
B1299S-3†	3	3	> 90	100	50	50	0
B1355S-4†	3	3	> 90	100	57	8	35
B1355-fraction S*	3	3	> 90	95	56	9	35
B1351-fraction L*	3	3	> 90	25	85	4	11

(*Continued on page 547*)

dextrans of high molecular weight are also inert, suggesting that molecular weight alone does not determine activity. No simple physical or chemical relationship exists between these compounds and their ability to bind properdin or inactivate C'3. There is some suggestion, however, that the degree of chain branching may be important. It should also be mentioned that, while the relative percentage of 1, 3 and/or 1, 4 linkages appears to be of importance in this respect, some differences have been found in behavior of dextrans that contain these linkages.

3) Native levans, with the exception of levan II (Hestrin), remove properdin almost completely from serum. It is interesting that levan II has little infection-promoting activity. However, all levans tested inactivate C'3. Properdin could be eluted from the levan-properdin complex in the usual manner.

4) A glucan prepared from yeast (*15*) behaves like FL-145, removing properdin alone from serum, while another glucan, Laminarin (*16*), combines with properdin and also inactivates C'3. A yeast mannan (*15*) is entirely ineffective in the properdin system.

It has been shown that antiserums to several pneumococcal polysaccharides cross-react immunologically (*17*) with some dextrans, suggesting similarities between the properties of these polysaccharides. Table 1 shows the results of the interaction of several pneumococcal polysaccharides with the properdin system. The polysaccharide from type XIV pneumococcus and to a lesser extent from type IV readily remove properdin from serum and inactivate C'3, while type VIII is not active against the properdin system. All of these compounds inactivate C'1, C'2, and C'4, indicating that complement fixation also occurs. This may account for certain peculiarities encountered in the assay of properdin and C'3 in the presence of these compounds. This, along with a lack of precise chemical and physical data for these agents, made it necessary to postpone further studies of the interaction of pneumococcal polysaccharides with the properdin system.

A carbohydrate isolated from *H. pertussis* (*18*) combines with properdin but does not inactivate C'3. This resembles the action of some of the afore-described dextrans.

Mucins and Ground Substance Components

It has been shown that the addition of mucins to serum *in vitro* (*19*) removed the bactericidal activity of serum and that the injection of mucin into guinea pigs resulted in a marked decrease

in the bactericidal activities of their serums. Therefore, it seemed important to determine the effect of several mucins on the properdin system. Crude hog gastric mucin (Armour) removes properdin and partially inactivates C'3. Another mucin (Rowley) combines with properdin but does not inactivate C'3. A mouse microsomal intestinal fraction (*20*) also combines with properdin. Other high molecular weight substances of mammalian origin are under investigation.

Reports in the literature (*21*) have suggested that certain rheumatoid diseases, diseases involving connective tissue or ground substance, and many inflammatory reactions may involve an immunological response of the host to the components of the ground substance. However, hyaluronic acid, the fundamental dimer of hyaluronic acid (*22*), chondroitin sulfate, heparin, and hyaluronidase (bull testes) are inactive on the properdin system (Table 3). None of these substances combines with properdin. Heparin is highly anticomplementary at the levels employed, making assays unreliable. The complete inactivity of the highly charged hyaluronic acid and chondroitin sulfate is surprising in view of the anticomplementary properties of heparin.

Requirements for Complement and Mg^{++}

Although kaolin and charcoal, as well as both anionic and cationic resins, do not combine with properdin, the possibility still existed that the removal of properdin from serum by the afore-mentioned agents was due to nonspecific adsorption and did not resemble the combination of properdin with zymosan, which requires the presence of C' and Mg^{++} (*1*). Accordingly, the requirements for the removal of properdin by levan, mucin, and endotoxin were studied. Purified properdin alone is not absorbed by these agents, as is shown in Table 4. The data also show that the inactivation of C' prevents the combination of properdin with these agents. It will also be noted that combination with properdin does not occur in the absence of Mg^{++}. Thus, C' and Mg^{++} are necessary for the combination of properdin, not only with zymosan, but also with other carbohydrates, carbohydrate complexes, and endotoxins.

Table 5 shows the requirements for properdin, C', and Mg^{++} in the inactivation of C'3 by levan. It will be noted that levan does not inactivate C'3 in the absence of Mg^{++}, C', or properdin. This is identical with the requirements for the inactivation of C'3 by zymosan (*1, 23,*

Table 2.—(*Continued*)

Sample	Maximal amount added to each milliliter of human serum		Removal or inactivation of properdin (%)	Inactivation of C'3 (%)	Type AGU links*, †		
	For removal of properdin (mg)	For inactivation of C'3 (mg)			1,6 (%)	1,4-like (%)	1,3-like (%)
B1146*	3	3	> 90	0	96	4	0
B1191*	3	3	> 90	0	71	14	15
B1254-fraction S*	3	3	> 90	0	93	7	0
B1402*	3	3	> 90	0	66	34	0
B742-fraction C-3R†	3	6	75	0	61	18	21
B1399-fraction L*	3	6	50	0	81	19	0
B1064*	3	3	50	0	95	5	0
B742-fraction L-R†	3	6	0	0	81	19	0
B1355I-C†	3	6	0	0	88	9	3
B1424*	3	6	0	0	72	28	0
B1375†	3	6	0	0	81	6	13
B512*	5	5	0	0	95	5	0
Native levans							
B1072*	3	3	75	100			
B512-E*	3	3	> 90	100			
Levan I§	2	1.5	> 90	100			
Levan II§	3	1.5	25	100			

* Samples and analytic data furnished by Allene Jeanes and F. R. Senti, Northern Utilization Research Branch, U.S. Dept. of Agriculture, Peoria, Ill. (*40*).
† Samples and analytic data furnished by Elvin A. Kabat, Columbia-Presbyterian Medical Center, New York, N.Y.
‡ Clinical dextrans furnished by M. H. Sloan, National Research Council, Washington, D.C.
§ Samples furnished by S. Hestrin, Hebrew University, Hadassah Medical School, Jerusalem, Israel.

Table 3. Effect of mucins, components of ground substances, and other agents on the properdin system in human serum

Sample	Maximal amount added to each milliliter of human serum		Removal or inactivation of properdin (%)	Elution of properdin from P-sample complex	Inactivation of C'3 (%)	Anticomplementary or inactivation of other components of C'
	For removal of properdin (mg)	For inactivation of C'3 (mg)				
Hog gastric mucin*	2	5	> 90		0	Yes
Hog gastric mucin†	3	3	> 90	+	50	Yes
Mouse microsomal intestinal fraction	3	3	> 90	+	0	Yes
Heparin	3	3			50	Yes
Hyaluronic acid (Na salt)	3	3	0		0	No
Hyaluronic acid (dimer)	3	3	0		0	No
Hyaluronidase	3	3	0		0	No
Chondroitin SO_4 (Na salt)	3	3	0		0	No
Pectic acid (Na salt)	3	3	0		0	No
Kaolin	10	10	0	–	50	Yes
Charcoal	10	10	0		0	No
Normal serum control			0		0	No

* Supplied through the courtesy of Derrick Rowley, Wright-Fleming Institute, London, England.
† Commercial product, Armour Laboratories, Chicago, Ill.

Table 4. Requirements for complement and Mg^{++} in the combination of properdin with hog gastric mucin, levan I, and endotoxin. All serum mixtures were incubated for 1 hour at 17°C. The samples were then centrifuged at 35,000 *g* for 1 hour, and the supernatants were tested for properdin activity.

Sample	Added properdin (units/ml serum)	Hog gastric mucin* (mg/ml serum)	Removal of properdin (%)
Normal serum		0	0
Normal serum		3	> 90
Properdin-deficient serum (RP)	6	0	0
Properdin-deficient serum (RP)	6	3	> 90
Veronal buffer alone	6	3	0
C'4-deficient serum (R4)		0	0
C'4-deficient serum (R4)		3	0
Resin-treated serum		0	0
Resin-treated serum		3	0
Resin-treated serum + Mg^{++}†		3	> 90
Resin-treated serum + Ca^{++}†		3	0

* Identical results were obtained with levan I and typhoid endotoxin.
† Final molarity of $Mg^{++} = 5 \times 10^{-4}$; of $Ca^{++} = 2.5 \times 10^{-3}$.

Table 5. Requirement for properdin, complement, and Mg^{++} in the inactivation of C'3 by native levan I (Hestrin). All serum mixtures were incubated for 1 hour at 37°C. The samples were then centrifuged at 35,000 *g* for 1 hour, and the supernatants were tested for C'3 activity.

Sample	Levan I (mg/ml serum)	Inactivation of C'3 (%)
Normal serum	0	0
Normal serum	3	100
Properdin-deficient serum (RP)	0	0
Properdin-deficient serum (RP)	3	0
Properdin-deficient serum (RP) + 3 units properdin	3	100
C'4-deficient serum (R4)	0	0
C'4-deficient serum (R4)	3	0
Resin-treated serum	0	0
Resin-treated serum	3	0
Resin-treated serum + Mg^{++}*	3	100
Resin-treated serum + Ca^{++}*	3	0

* Final molarity of $Mg^{++} = 5 \times 10^{-4}$; of $Ca^{++} = 2.5 \times 10^{-3}$.

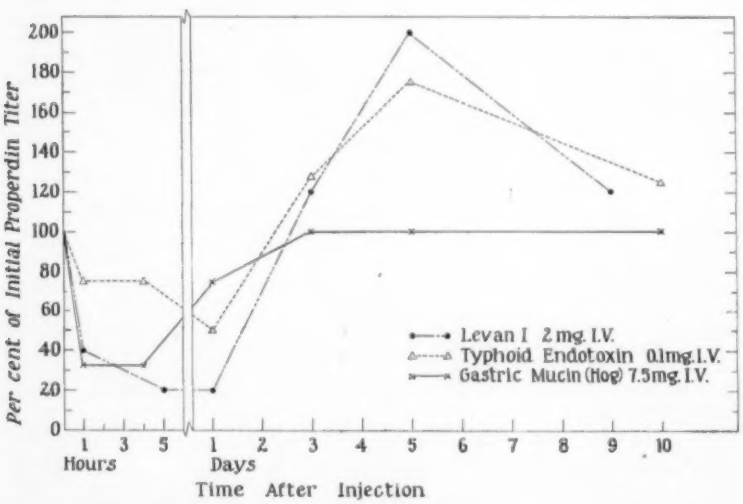

Fig. 1. The serum properdin levels in mice following intravenous injection of levan, mucin, and endotoxin.

24). The addition of properdin to properdin-deficient serum and the addition of Mg^{++} to resin-treated serum then allowed levan to inactivate C'3.

These experiments clearly show that the interaction of the properdin system with the afore-mentioned agents is dependent on the same conditions required for zymosan.

Possible Relationships to Natural Immunity

Most of the substances that have been shown to combine with properdin and to inactivate the properdin system have previously been demonstrated to have definite infection-promoting activity (*25*). These include dextrans and levans, hog gastric mucins, bacterial cell walls, and other bacterial carbohydrates.

Zymosan (*7*) and the cell walls of *E. coli* (*8*) have been shown not only to increase susceptibility but also to increase resistance to infection, depending on the time interval between the injection of these agents and the infection of the animal. Within the first few hours following the injection of zymosan or cell walls the animals are highly susceptible, whereas 2 to 5 days later they are resistant to various bacteria. Paralleling the degree of susceptibility of the animal to infection is a fall and rise in properdin levels during the same time interval, which suggests a relationship between serum properdin level and susceptibility or resistance to certain infections. The identical behavior of zymosan and the *E. coli* walls *in vivo* again suggests that they may contain similar compounds or structures.

It seemed important to determine the effect of levan, mucin, and endotoxin on the serum properdin levels *in vivo*. The results of such experiments are presented in Fig. 1, which shows that both levan and mucin produce a marked and rapid fall in properdin within a few hours after injection into mice; this is followed within 3 to 6 days by a return to normal levels in the mucin-treated mice and to a level of 200 percent of normal in the levan-treated mice. The injection of endotoxin caused a slight fall in properdin levels during the first 4 hours following injection, a more pronounced fall at 24 hours, followed by a marked increase in properdin levels between 3 to 6 days. All properdin levels had returned to normal values at about 10 days after the injections. Studies are in progress on properdin levels following the injection of varying amounts of these agents at different times.

The foregoing experiments suggest that the ability of mucins (*25–28*), levans (*14, 25*), and endotoxin to influence the resistance or susceptibility of laboratory

animals to infections may be due in part to their interaction with the properdin system. The interaction of endotoxins with properdin also suggests that the properdin system may be involved in "tolerance" to endotoxin (*29*), in the Shwartzmann reaction, and in the pyrogenic and other physiologic manifestations of endotoxins. The relationship of properdin to the normal serum factor (*30, 31*) that has been reported to react with endotoxin is under investigation. Along these lines, the increased sensitivity to endotoxins of dogs subjected to irreversible hemorrhagic shock (*32*), which is accompanied by a marked decrease in their serum properdin levels (*33*), should be noted.

Although a variety of high molecular weight carbohydrates or their complexes cause marked changes both in natural resistance and in the properdin system *in vitro* and *in vivo*, no definite correlation exists between the activities of these materials and any simple physical or chemical property. Polysaccharides with identical repeat units and very similar structures present widely different activities. The active materials contain both α- and β-linkages, furanosidic and pyranosidic units, and interhexose linkages of 1, 4; 1, 6; 1, 3; 2, 1; and 2, 6 types and combinations of these within the same compound. There also seems to be no dependence on the presence or absence of polar groups. Perhaps specific configurations or spatial arrangements of sugar residues may determine the ability of macromolecules, as well as certain bacteria, viruses, and red cells, to interact with the properdin system. In any event, the requirements of C′ and Mg^{++} for the combination of properdin clearly indicate that the mechanisms involved are highly complex and that further comment at this time would be highly speculative and premature.

Appendix

Nomenclature. Properdin is designated as P, complement as C′, and zymosan as Z. The four recognized components of C′ are indicated by the symbols C′1, C′2, C′3, and C′4 (*34*). RP indicates serum lacking properdin only and R3 lacking both C′3 and properdin. R4 is serum rendered free of C′4 by treatment with hydrazine (*35, 36*). The preparation of resin-treated serum that is deficient in Mg^{++} and Ca^{++} has been described previously (*37*).

General methods. Methods for the assay of properdin (*1*), C′, and C′ components (*1, 37, 38*) have been previously described. The various agents tested for their effect on the properdin system were dissolved or suspended before use to a concentration of 10 mg/ml in Veronal buffer (*39*) containing Mg^{++} and Ca^{++}. Desired amounts of these substances were then added to human serums previously selected for their ability to make satisfactory R3 or RP reagents by zymosan treatment. About 20 percent of human serums make suitable RP and only 10 percent make suitable R3. These mixtures, along with normal treated and untreated serum controls, were then incubated at 37°C for 1 hour with occasional mixing, then centrifuged at 35,000 *g* at 2°C for 1 hour, and the supernatants were tested for properdin, C′3 activity, and other C′ component activities. The presence of agents *that did not sediment at 35,000 g* interfered with both the properdin and the C′3 assays.

In certain instances, the afore-mentioned mixtures were incubated at 17°C instead of 37°C and treated as just described, and the supernatants were tested for properdin only. Some residues were eluted with buffer of *p*H 7.4 and ionic strength of 0.6, and the eluate was tested for properdin. Such tests verified the actual combination of properdin and eliminated the possibility of nonspecific inactivations.

To test the *in vivo* action of various agents on the properdin system, healthy 12- to 16-g CF2 female mice were injected intravenously with various doses of levan, mucin, and endotoxin dissolved or suspended in 0.15*M* NaCl. Changes in the properdin content of the blood were followed by doing titrations on pools of at least six serums obtained from groups of animals sacrificed at various times before and after injection. The serum samples were frozen and stored at −30°C in a mechanical deep freeze until the final sample had been obtained. Properdin titrations were then done on all samples with the same reagents on the same day.

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The truth is never simple, and rarely pure.—OSCAR WILDE.

News of Science

New Editor for AAAS Journals

On 1 Jan. 1956 Graham DuShane, professor of biology on leave from Stanford University, will become editor of *Science* and *The Scientific Monthly*. Chosen after careful search, DuShane brings to this important post an admirable combination of editorial and scholarly talents. Born in Indiana in 1910, DuShane graduated from Wabash College in 1930 and entered the graduate school of Yale University to study embryological problems with Ross G. Harrison. After receiving the doctoral degree (1934), he spent two research-years at the University of Iowa (1934–35) and Stanford University (1935–36)—the latter on appointment as National Research Council fellow. In 1936 DuShane joined the staff of the department of zoology of the University of Chicago, where he remained for 10 years. In 1946 he returned to Stanford with the rank of professor and there has been primarily concerned with furthering the university's program in general biology and embryology.

Such a brief, although notable, biography does not in itself make explicit the qualifications of the man for the exacting position he has consented to accept. Responsibility for appointing the editor rests with the board of directors of the Association. In sessions devoted to this task the board saw merit in recruiting an able person with a background of professional journalism, provided that he had consistently demonstrated deep understanding of the affairs of science. Alternatively, the argument was advanced (and perhaps with greater frequency) that science should be run by its practitioners: that the editor should be a broadly informed scientist endowed with an urge and the flair to *communicate* the findings, and implications, of science with vigor and judgment. Actually, the final decision was reached, not so much on the basis of past training, but in the time-honored way of seeking the best man. This led to DuShane.

Numerous distinctions have come to DuShane in research and in teaching. His work on amphibian morphogenesis is widely and appreciatively cited. His research papers are characterized by a balance, all too rare, of history, analysis, and synthesis. Indeed, his writings in general (including correspondence) are both originally phrased and broadly informed. His success as a teacher is equally noteworthy. In partial documentation of this may be mentioned the award of the $1000 prize for excellence of undergraduate teaching at the University of Chicago, the acknowledged success of his biology courses at Stanford University, and the publication of two manuals for laboratory instruction. Also at Stanford, DuShane spent much time as a member of appointive and elective faculty committees devoted largely to educational planning and matters of curriculum. It is reasonable to say that these experiences have taught him much about human behavior, including the possibilities of agreement and disagreement. This background certainly will stand him in good stead as he faces the actual problems of an editorship. In 1951–52 he was president of the Stanford chapter of the American Association of University Professors and held a similar office for the Society of the Sigma Xi in 1955–56.

DuShane's advice has been frequently sought by both commercial and academic publishers as well as by editors of learned journals. In this role his response has been generous and cogent, and it is not too much to assert that frequently he has quietly improved manuscripts and suggested areas that merit further treatment in the literature. At one time DuShane was a consultant in biology to the *Encyclopaedia Britannica*, and he still prepares each year an informative article on zoology for their *Book of the Year*.

Those of us who have known Graham DuShane as colleague and friend are sincere in our belief that his editorship will be distinguished. His unusually comprehensive knowledge of science in general, his impatience with false notions of hierarchies among the several sciences, his facility with the written and spoken word, and his conviction that science and scientists deserve expert interpretation to the public, all augur well for the future of our two journals.

We welcome DuShane to his new position and what we hope will be his new career.

THOMAS PARK
Hull Zoological Laboratory, University of Chicago

Poverty Point Excavations

Archeological materials that were excavated last spring from Poverty Point site on Bayou Macon, 5 miles northeast of Epps, La., are being studied and cataloged by James A. Ford, associate curator of North American archeology at the American Museum of Natural History. He headed a study group that included Junius B. Bird, associate curator of archeology at the American Museum of Natural History, and Stewart Neitzel, archeologist of the Louisiana State Parks Commission.

According to Ford, Poverty Point, which is the site of the oldest known village in the lower Mississippi Valley, was inhabited by an advanced Stone Age Indian people between 800 and 400 B.C., and the initial settlement marked the beginning of what may be called the "American Neolithic" period. Focal point of the ancient community was a great mound of earth that was constructed in the shape of a flying bird. The mound is now 70 feet higher than the surrounding alluvial flats.

The remains of the village are a few hundred yards east of the great mound; they form a half-octagon about ¾ mile in diameter. The houses were built on artificial ridges that formed concentric octagons, and excavations have shown that the sides of these ridges served as refuse heaps for the community.

A second mound, some 56 feet high and lying to the north of the village, is also constructed in the shape of a bird. The artificial nature of both bird-effigy mounds is beyond question, Ford reported, for examination of their earth has revealed the imprints of baskets used to carry clay for their construction. The absence of human artifacts in both mounds indicates that they served some purpose other than habitation.

Excavation of a third mound close to

the village disclosed a charred fragment of human bone—the first bone of any kind to be found at the site. This and other unidentifiable bone fragments, found in an extensive ash bed, constitute possible evidence of cremation.

In light of his discoveries and the dates assigned by radioactivity measurements to several specific articles, Ford believes that the Poverty Point culture may represent the earliest southward movement of people of the Hopewell culture.

Artifacts recovered by Ford's group show that the prehistoric inhabitants of the village had begun to make clay pottery as well as utensils of copper and soapstone. They used hematite bolas and fashioned jewelry out of quartz and jasper. Because many of the raw materials used in these artifacts do not occur naturally in Louisiana, their presence is considered to be evidence that the villagers traded with people of other regions.

The use of bird effigies, both in earth mounds and on vessels and ornaments, is not uncommon in "American Neolithic" cultures, Ford said. Bird effigies seem to have had religious significance and to have figured in ceremonies and cures. However, the giant bird represented in the large mound at Poverty Point appears to be flying due north, while the bird of the smaller mound is headed due west. The directions, in each case, are within a single degree of the true direction. The knowledge of astronomy implied, together with the geometric design of the villages, indicates a greater familiarity with the rudiments of science than has been heretofore attributed to aboriginal Americans.

News Briefs

■ The following research projects were reported in the 6 Aug. issue of *Nature*.

The chromosomes of palms have been almost impossible to study because of their habit of clumping. A. K. Sharma and S. K. Sarkar of the University of Calcutta have now found that excellent fixation and spreading of these refractory chromosomes may be obtained by treating the root-tip cells with aesculine, an alkaloid obtained from the horse-chestnut. None of the chemical agents satisfactory with other plants has served to do this.

J. Langridge of the University of Adelaide reports that he has obtained a biochemical mutation in one of the flowering plants, the cruciferous *Arabidopsis thaliana*. By developing a method for growing it in aseptic culture, he obtained after x-ray treatment a mutant type that is unable to synthesize thiamine (vitamin B_1).

A recent study of the polyhedral virus, which causes a blood disease in the cranefly, *Tipula paludosa*, reveals that the multiplication of the virus takes place inside the nuclei of the blood cells. Kenneth M. Smith, of the Virus Research Unit, Cambridge, England, has published electron micrographs which show that the rod-shaped virus particles form in the nucleus, that each becomes surrounded by a vesicle, and that these vesicles collect into an aggregate inside the nuclear membrane. Then the vesicles appear to contract, and eventually a polyhedral crystal of the virus is extruded into the cytoplasm.

B. P. Wiesner and J. Yudkin of the University of London have tested the effects of a variety of antimitotic agents upon the fertility of mice. One of these agents, podophyllin, regularly interrupts pregnancy when administered 3 days or more after the time of mating. No resistance to the drug seems to be built up, and full fertility returns when the drug is no longer administered, at least after 3 interrupted pregnancies had occurred. The drug was not effective when administered immediately after mating. It produced no noticeable side-effects. —B.G.

■ An expedition of the Academy of Natural Sciences of Philadelphia left for Peru on 10 Sept. to make a study of the aquatic life of the Amazon. The two sites to be studied are Iquitos and Tingo Maria. Ruth Patrick, curator of limnology, heads the expedition group, which consists of Matthew H. Hohn, algologist; Selwyn S. Roback, entomologist; Frederick A. Aldrich, invertebrate zoologist; Yvonne Swabey, chemist; John Cairns, Jr., protozoologist; Charles C. G. Chaplin, associate in the academy's fish department; and Josephine deN. Henry, associate in the photography department.

The expedition is supported by the Catherwood Foundation of Bryn Mawr, Pa., of which Cummins Catherwood is president. This foundation sponsored a preliminary visit to the Amazon headwaters in June, when Patrick, Hohn, and H. Radclyffe Roberts, director of the academy, selected the survey sites.

The purpose of the expedition is to determine whether or not there is a greater diversity and a greater abundance of aquatic life in tropical streams than in similar ones in the temperate zone.

Two methods of study will be used. In one a group of scientists will collect the various groups of aquatic life in selected sections of the river; identify their species, and correlate them as to numbers and kinds with findings in similar temperate-zone rivers. The second method will employ the Catherwood diatometer, an instrument containing laboratory slides that is floated in streams to collect diatoms. The structure of the population of diatoms will be compared with populations in similar temperate-zone rivers.

■ The Army is cutting back on its privately contracted bacteriological and chemical warefare research at Camp Detrick, near Frederick, Md. A $2,750,000 annual contract with the Ralph M. Parsons Co. of Los Angeles was terminated in August. The firm is said to have employed 450 persons at Detrick.

■ The Tennessee Valley Authority has announced a 5-year extension of its fertilizer research and testing contracts with agricultural experiment stations in eight states. Included are the seven Tennessee Valley states of Alabama, Georgia, Mississippi, Tennessee, Virginia, North Carolina and Kentucky, and the State of Washington.

■ The Norwegian Meteorological Institute is expanding its radio meteorographic station on Bear Island and establishing a new station at Isfjord in Spitzbergen as part of a plan to improve weather forecasting in the arctic regions. Norway also operates meteorological stations at Jan Mayen and Hopen in the Arctic.

Scientists in the News

E. DAHL-IVERSEN, professor of surgery at the University of Copenhagen, Denmark, will deliver this year's Charles H. Mayo memorial lectures at Northwestern University medical school. On 26 Oct. he will discuss the functions of the endocrine organs during the postoperative period.

Dahl-Iversen, well-known for his surgical work in the field of endocrine glands, is also chief of surgical services of the University Surgical Clinic at Rigshospitalet, Copenhagen. He is to be awarded an honorary fellowship in the American College of Surgeons at its annual clinical congress which meets in Chicago, 31 Oct.–4 Nov.

HENRY H. BABCOCK, former superintendent of the Butler Hospital in Providence, R.I., has been appointed to the staff of the department of hygiene at Harvard University. Butler Hospital, a 111-year-old institution for the mentally ill, was forced to close because of mounting operating deficits.

EDWARD F. HAMMEL of the University of California's Los Alamos Scientific Laboratory has been selected as the recipient of the American Chemical Society's California Section award for

1955. The award, a gold medal, will be presented during a section meeting that will take place on 10 Oct. at the University of California, Berkeley. Following the presentation Hammel will talk on "Helium 3 and its relationship to the problem of liquid helium." The award was established in 1950 for the purpose of recognizing outstanding achievement in the field of chemistry or chemistry technology by a young scientist from one of the 11 western states.

FRANCISCO GRANDE, associate professor of physiological hygiene at the University of Minnesota, left on 18 Sept. to make a 6-week lecture tour of 12 major Central and South American medical centers. At Minnesota he is concerned with the study of the relationship of diet and activity habits to degeneration of the heart and blood vessel system. During his Latin American trip he will lecture on human nutrition, a subject on which he has written three books and 130 scientific papers.

A graduate of the University of Madrid medical school, Grande had conducted research in several European countries before he came to the United States; he joined the Minnesota staff in 1953. Charles Pfizer and Co., Inc., New York, is sponsoring his current trip.

LUCIEN A. BAVETTA, professor of biochemistry and nutrition in the School of Dentistry, University of Southern California, has been appointed to serve for 1 year as visiting scientist in the National Institute of Dental Research, Bethesda, Md. He will work in the Laboratory of Oral and Biological Chemistry, where he will expand his research on the relation of certain dietary deficiencies to the development of diseases of the teeth.

NATHANIEL B. NICHOLS, an authority on servomechanisms and other intricate electronics apparatus, has been named manager of Raytheon Manufacturing Co.'s commercial equipment engineering activities. He was formerly manager of the firm's research division. The appointment is part of the Waltham, Mass., firm's reorganization of its equipment operations, a reorganization designed to establish separate facilities for Government and commercial products.

WILLIAM RANDOLPH TAYLOR, professor of botany at the University of Michigan, has been elected foreign member of the Linnean Society of London.

MARTIN G. GALE has been named director of technical service for the monomer department of the Borden Co.'s chemical division. Gale, who has more than 10 years of experience in the formulation of adhesives, coatings, and impregnants, will head the technical service laboratory in Leominster, Mass. The laboratory offers free technical advice and assistance to industrial users of polyvinyl alcohol, polyvinyl acetate, and a wide variety of other natural and synthetic resins manufactured by Borden's.

LEO M. TARAN has announced his resignation as medical and research director at St. Francis Hospital and Sanatorium for Cardiac Children, Roslyn, N.Y. He has been connected with the hospital since its founding in 1938. During its 18-year existence the institution has grown from a convalescent home for children recovering from rheumatic fever to a hospital for the treatment of all forms of heart disease in children and young adults. It has become a center for cardiologic research and teaching in pediatric cardiology. Taran has opened offices at the Garden City Medical Center, Garden City, N.Y.

JOHN J. GILMAN, metallurgist at the General Electric Research Laboratory, has been named winner of the 1956 Rossiter W. Raymond memorial award, which is presented by the American Institute of Mining and Metallurgical Engineers. The award is given each year to the AIME member under 33 years of age who has written the technical paper judged to be most outstanding on the basis of technological content, proficiency of organization, and literary style. Gilman was honored for his article, "Study of a new mode of plastic deformation in zinc crystals" that was published in the *Journal of Metals*.

SAMUEL A. GOLDBLITH, associate professor of food technology at Massachusetts Institute of Technology, has been appointed executive officer of the institute's department of food technology. He has been a member of the staff since 1949.

HARRY L. OWENS, former chief of the solid-state devices branch at the U.S. Army Signal Corps Engineering Laboratories, Fort Monmouth, N.J., has joined Texas Instruments, Inc., Dallas, as chief engineer of the semiconductor products division. He will be responsible for the development and engineering of germanium and silicon semiconductor products. The company is a producer of high-temperature silicon transistors as well as of general-purpose germanium transistors and silicon junction diodes.

ISAO IMAI, professor of physics at the University of Tokyo, Tokyo, Japan, will serve as a visiting professor at the University of Maryland during the fall term. He will be attached to the Institute of Fluid Dynamics and Applied Mathematics, where his activities will include the conduct of a weekly seminar on approximation methods in fluid dynamics.

AUSTIN B. WILLIAMS, acting director for the University of North Carolina Institute of Fisheries Research at Morehead City, has accepted appointment to the regular faculty of the University of Illinois, Chicago, in the department of biology. Williams has been in charge of shrimp investigations at the Institute of Fisheries Research for the past 4 years.

PAUL WEBER, professor of chemical engineering and director of the School of Engineering at Georgia Institute of Technology, has been named dean of faculties.

CHERRY L. EMERSON, vice president of Georgia Institute of Technology, retired from that post on 30 June. Emerson, who is a graduate of the institute, joined the staff in 1945 as dean of engineering, and has served as vice president since 1948. He plans to enter practice in Atlanta as a consulting engineer.

G. H. BENHAM, for the past 5 years supervisor in charge of biochemistry research at the Armour Research Foundation, Chicago, Ill., has been appointed director of research and process development for the American Agricultural Chemical Co.

GERALD H. LOVINS, for 15 years research director for the American Instrument Co., Inc., Silver Spring, Md., has joined the research staff of the Photovolt Corp., New York, where he will devote most of his time to the development of new products.

ALAN C. BURTON, professor of biophysics at the University of Western Ontario, will deliver the Montreal Clinical Society's Louis Gross memorial lecture on 1 Nov. during the annual fall convention of the Montreal Medico-Chirurgical Society. He will discuss the "Clinical importance of the physiology of temperature regulation."

R. GRANT ATHAY, member of the senior scientific staff of the High Altitude Observatory of the University of Colorado, Boulder, has accepted a 1-year appointment at the Harvard College Observatory, Cambridge, Mass., effective this month. Athay's recent work has been concerned with the reduction and analysis of the data obtained by the Khartoum eclipse expedition that was conducted by the High Altitude Observatory in 1952.

WALTER J. BURDETTE, former professor of surgery at Louisiana State University, has been appointed chairman of the department of surgery in the new School of Medicine at the University of Missouri. He has published more than 75 scientific papers on the biology of cancer, cardiac surgery, and experimental surgery.

FRANK FALKNER, research assistant and lecturer in child health in the Institute of Child Health, Hospital for Sick Children, London, has been appointed assistant professor of child health at the University of Louisville, effective in Jan. 1956. Falkner is also coordination officer to the Centre International de l'Enfance, Paris, for its program of growth studies. These studies are taking place in various countries, but to date there are no North American participants. Falkner, who will retain his appointment in Paris, plans to establish a cooperating study in Kentucky.

STEWART T. GINSBERG, manager of the new Veterans Administration neuropsychiatric hospital in Pittsburgh, Pa., will shortly be transferred to VA's central office in Washington, D.C., to head the psychiatry d[illegible]n of the psychiatry and neurology service. Succeeding Ginsberg at Pittsburgh will be LEE G. SEWALL, manager of the VA neuropsychiatric hospital at Downey, Ill.

The following appointments to assistant professor have been announced. West Virginia University: JAMES FRANCIS HAMILTON, mechanical engineering. Michigan State University: JOHN CLARK BALLARD, research, horticulture; JOHN DIXON DOWNES, research, horticulture; HUGH NELSON MOZINGO, natural science; HAROLD BERTRAM STONEHOUSE, geology; ROBERT LOUIS BLAIR, mathematics; WILLIAM HAROLD KELLY, physics and astronomy; OLIVER W. KAUFMAN, microbiology and public health.

Necrology

JAMES T. BLACK, Vineland, N.J., 62, research director of the New Jersey Poultry Laboratory of Rutgers University Agricultural Extension, 1 Sept.

GEORGE C. CLARKE, New York, 85, industrial engineer who built the Pennsylvania Railroad terminal in New York, 5 Sept.

LORD COURTHOPE, Wadhurst, England, 78, a member of Parliament for 40 years and a naturalist who advocated conservation of Britain's natural resources, former president of Royal Agricultural Society, 2 Sept.

ALBERT HEYNINX, Brussels, Belgium, 78, former medical specialist to the royal family in Belgium and honorary professor at Brussels University, 30 Aug.

JOSEPH F. D. HOGE, New York, 74, former product design engineer with Bell Telephone Laboratories who specialized during World War II in the mechanical design of battle announcing systems for the Navy, 5 Sept.

WALTER KEPLER, SR., Wynnewood, Pa., 71, assistant in the department of chemistry and instructor in roentgenology at Hahnemann Hospital, Philadelphia, Pa., 1 Sept.

ARTHUR W. MILLER, Washington, D.C., 78, retired chief of the Bureau of Animal Industry of the U.S. Department of Agriculture, 30 Aug.

EDUARD PERNKOPF, 67, German anatomist, emeritus professor at the University of Vienna, and director of the Institute of Systematic Anatomy until 1945, 17 Apr.

WILLIAM E. SAUER, St. Louis, Mo., 80, professor of otolaryngology at St. Louis University School of Medicine and inventor of surgical instruments and operating techniques bearing his name, former director of the school's department of otolaryngology, 3 Sept.

HEWITT S. WEST, Las Vegas, Nev., 65, mining executive; president of Haile Mines, Inc., which controls the Tungston Mining Corp. and Manganese, Inc., two of the largest producers of these metals in the United States.

Education

■ The recent opening of the Albert Einstein College of Medicine in the Bronx marks the first time in nearly 60 years that a new medical school has been founded in New York State. Almost every current report on manpower problems points to the need for more doctors, dentists, and nurses. American hospitals have 12,000 internships available and only 6000 interns to fill them. There are 19,000 residencies and only 12,000 doctors available. This country is graduating only one new doctor for each 30,000 people; it is estimated that by 1960 there will be a shortage of from 30,000 to 40,000 physicians.

Expansion programs for medical education are under way in various parts of the country. Last year the University of California at Los Angeles graduated its first class. The University of Miami will graduate its first class next June. The University of Mississippi completed a $9-million construction plan and will admit its first third-year class in June. The University of Missouri is also undergoing a conversion from a 2-year science to a 4-year medical college. The University of Florida will admit its first medical class next June. Seton Hall College of Medicine in Jersey City, N.J., will open in the fall of 1956, under present plans.

These developments probably represent a greater growth in medical school facilities than in any comparable period; however, many authorities doubt that the additional facilities will be enough to meet the needs of an increasing population and an expanding military, as well as the development of new medical and health practices.

Further, a disturbing fact will be brought out in the annual report of the American Medical Association's Council on American Education and Hospitals, to be issued 8 Oct. The report will show that the number of applicants for medical school admission has dropped drastically in recent years. In 1954–55 there were about 15,000 applicants for the 7500 positions in the entering class. This group of 15,000 made 47,000 applications (an average of about three applications for each student). Three years ago there were more than 20,000 candidates for medical schools; and, three years ago, one out of every 3.6 applicants was accepted. Last year, one out of every 1.97 found a place in a medical school.

■ Stevens Institute of Technology celebrated the 25th anniversary of its evening graduate program in engineering and science when its first classes of the 1955–56 term began on 22 Sept. Although the institute has offered graduate work almost since its founding in 1870, the formal evening sessions were not started until 1930. The enrollment in the graduate program has grown since then to just under 800.

■ The Westinghouse Educational Foundation has embarked on a $4-million program in support of education that includes: (i) contributions to universities' regular operating expenses; (ii) contributions for building and building equipment; (iii) contributions toward laboratory apparatus; (iv) encouraging higher education through aid to students and teaching.

In a brochure of announcements, each of the four aspects of this plan is described in some detail. Emphasis is placed not only on past accomplishment, but also on future objectives as visualized by the trustees of the foundation. The trustees, believing that privately endowed institutions are truly part of this country's heritage, have now committed the foundation to a 5-year program of contributing to the operating expenses of these institutions.

Some 100 engineering, liberal arts, and business colleges will benefit from

this program. They will be permitted to apply the funds to their normal operating expenses in areas where aid is most needed. In the main, each school selected to receive this support will be granted two equal contributions during the 5-year interval, 1955 to 1959. Each school will receive during this period support ranging from $3000 to $15,000.

Because continuing expansion of facilities to meet growing college enrollments will be required during the next 5 years, the foundation has allocated funds to assist schools with their building programs. The foundation also intends to contribute funds to colleges and universities for the purchase of laboratory equipment.

The final portion of the brochure describes the foundation's program for encouraging higher education: scholarships, fellowships, and professorships; the Westinghouse Science Talent Search; the farm and home electric program (National Committee on Boys' and Girls' Club Work, Inc.); the science teachers' summer programs; the George Westinghouse award in engineering education; the Future Farmers of America Foundation, Inc.; the George Westinghouse gold medal award; and the metals research program at the Institute for Nuclear Studies–University of Chicago.

■ Academic courses leading to the degree of master of science and doctor of philosophy in the basic medical sciences of anatomy, microbiology, biological chemistry, pathology, pharmacology, and physiology, have been established at Hahnemann Medical College and Hospital of Philadelphia. The graduate program is intended for qualified graduates who are planning for a career in teaching and research. Information may be obtained from the chairman of the graduate committee, Prof. M. John Boyd, Hahnemann Medical College, 235 N. 15 St., Philadelphia 2, Pa.

■ The University of Tennessee Medical Unit's new $731,000 medical-surgical building was turned over to the university on 23 Aug. The 7-floor structure adds 40,000 square feet of floor space to the Memphis Medical Center. The building is south of Gailor Memorial Hospital; and the first four floors connect by corridors with the hospital.

■ A center for the study of fossil spores and pollen is being established by New York University this month. Made possible by grants from the Socony Mobil Oil Co. and the Texas Co., this is thought to be the first academic center of its kind in the Western Hemisphere. Brooks Ellis, who is chairman of the department of geology at the Graduate School of Arts and Science, has stated that the facilities will be used "to train graduate students in the technique, application, and solution of problems in petroleum geology through the analysis of spores and pollen."

Lawrence R. Wilson of the University of Massachusetts, an authority on spores and pollen, will make weekly journeys to New York from Amherst, Mass., during 1955–56 to lecture and to supervise the work of graduate students. The American Museum of Natural History's department of micropaleontology, which is headed by Ellis, will provide the laboratory and classroom space.

Grants, Fellowships, and Awards

■ The University of Michigan has announced how it will use a grant of $220,250 from the Ford Foundation. The grant is for the development and improvement of work in the behavioral sciences—psychology, sociology, anthropology, and aspects of political science and economics.

Terminal support for three research and training programs over a period of 3 years makes up $115,500 of the grant. Of this sum, $42,000 is for the Detroit Area Study, which is being administered by an interdepartmental faculty committee with Ronald Freedman as chairman. A study of political behavior under the direction of Samuel Eldersveld will receive $31,500. Research on the application of mathematics to the behavioral sciences, to be directed by C. H. Coombs, will receive $42,000. These projects were part of the program of research in individual behavior and human relations inaugurated with a $300,000 grant from the Ford Foundation in 1950.

Other uses of the Ford grant will be as follows: (i) $20,000 for 10 graduate fellowships in the behavioral sciences (each at $1000 a year for 2 years) to be administered by the School of Graduate Studies; (ii) $30,000 for support of a field research training program in anthropology for a period of 3 years under the direction of the department of anthropology; (iii) $42,000 to cover released time for research by the behavioral science faculty members and of the staff of the Institute for Social Research, to be administered by the School of Graduate Studies at the rate of $14,000 annually for 3 years; (iv) $12,750 for five stipends at the rate of $850 a year for 3 years to permit research training in social psychology; this will be administered by the committee for doctoral training program in social psychology of which T. M. Newcomb is chairman.

■ On behalf of the James Picker Foundation, the National Academy of Sciences–National Research Council has announced the continued availability of funds in support of radiological research. Applications are reviewed by the committee on radiology of the Division of Medical Sciences. Final determination of awards is made by the foundation upon recommendation of the committee.

The interests of the foundation are oriented toward, but not necessarily limited to, the diagnostic aspects of radiology. Awards are not restricted to citizens of the United States. Applications for the fiscal year 1956–57 *must be submitted on or before 1 Dec.* to the Division of Medical Sciences, National Academy of Sciences–National Research Council, 2101 Constitution Ave. NW, Washington 25, D.C.

Grants-in-aid are designed to encourage research offering promise of improvement in radiological methods of diagnosis or treatment of disease.

Grants for Scholars are a transitional form of support, designed to bridge the gap between the completion of fellowship training and the period when the young scientist has thoroughly demonstrated his competence as an independent investigator. A grant of $6000 per year will be made directly to the scholar's institution as a contribution toward his support, or his research, or both. Initial grants are limited to 1 year, but renewal may be recommended. Applications should be submitted by the institution on behalf of the candidate.

Fellowships in Radiological Research, available under the program of the Foundation, have been announced separately [*Science* **122**, (16 Sept. 1955)].

In the Laboratories

■ Effective 30 Nov., the Atomic Energy Commission will discontinue its program for the processing and distribution of cyclotron-produced radioisotopes because private industry appears to be prepared to assume this function. The decision will not affect the commission's program for the production and distribution of reactor-produced radioisotopes and electromagnetically concentrated stable isotopes. The bulk of the radioisotopes distributed by the AEC has been produced in reactors. The commission will also continue to perform, upon payment of applicable charges, service irradiations in its cyclotrons.

The AEC began the production, processing, and distribution of cyclotron-produced radioisotopes in 1949. The purpose of the program was to assist medical and biological research by providing radioisotopes that could not be produced in a nuclear reactor or could not be prepared from reactor-produced radioisotopes to meet activity specifications. The more important of these radioisotopes

are beryllium 7, sodium 22, arsenic 73 and 74, iron 59, zinc 65, and iodine 125.

A total of 793 shipments of cyclotron-produced radioisotopes with a total activity of 4065 millicuries was distributed from June 1949 through June 1955.

■ The Nuclear Science and Engineering Corp. of Pittsburgh, Pa., is the first private American firm to produce radioisotopes in cyclotrons in order to supply industrial and medical users. Under the new program the company will produce, on request, any isotope that can be made with a cyclotron; in addition, long-lived isotopes for which a demand exists will be stockpiled. At present, prices are comparable to Atomic Energy Commission rates. A catalog of current radioisotopes can be obtained by writing to the firm at Box 10901, Pittsburgh 36, Pa.

■ Consolidated Engineering Corp.'s systems division has moved into new and larger quarters in Pasadena, Calif. The division has leased 4200 square feet of a new $75,000 building near the company's main plant for its engineering and administrative operations. Formed only 18 months ago, the division has expanded its engineering staff fivefold in that time. Following careful study of customer requirements, systems engineers assume full responsibility for engineering, building, installing, and servicing automatic data-processing and industrial control systems.

■ The United Transformer Co., New York, has announced the start of operations at its new UTC-Pacific Division plant, located at 4008 W. Jefferson Blvd., Los Angeles, Calif. The plant is equipped with modern production facilities for the manufacture of all types of transformers, reactors, solenoids, variable-voltage transformers, control reactors, high-Q coils, and filters. Complete laboratory and test facilities have been provided.

■ Smith, Kline and French Laboratories will add a $2,487,000 wing to the firm's present building in Philadelphia, Pa. This structure will complete the company's $8-million expansion program started in 1954. The new wing will be completed by late 1956.

Miscellaneous

■ *Behavioral Science,* a new quarterly journal, official publication of the new Mental Health Research Institute at the University of Michigan, will begin appearing in Jan. 1956. It will contain articles on general theories of behavior and on empirical research specifically oriented toward such theories. An interdisciplinary approach to problems of behavior will be stressed. Although the scope of the journal will include all aspects of behavior which can be subsumed under broadly general interdisciplinary theory, in the field of application special emphasis will be placed on contributions relating to research in mental health and disease.

The editorial board will include Franz Alexander (psychoanalysis), Alex Bavelas (social psychology), David Easton (political science), Ralph W. Gerard (neurophysiology), Donald G. Marquis (psychology), James G. Miller (psychology and psychiatry), Jacob Marschak (economics), Anatol Rapoport (mathematical biology), Ralph W. Tyler (education), and Raymond W. Waggoner (psychiatry).

Subscriptions will be $6 a year. Manuscripts and subscription orders may be sent to Dr. James G. Miller, Mental Health Research Institute, University of Michigan, Ann Arbor, Mich.

■ *Medical Horizons,* a television series on accomplishments in medical research, presented the first of some 26 half-hour programs on 12 Sept. This initial production of the Monday evening series, which is being sponsored by CIBA Pharmaceutical Products, Inc., of Summit, N.J., in cooperation with the American Medical Association, showed a demonstration of the heart-lung "by-pass" machine recently developed at the Mayo Clinic; this instrument facilitates surgery on the interior of the human heart.

The program will present live telecasts featuring outstanding leaders in clinical and experimental medicine; it will be telecast from major medical centers throughout the country. The next six programs will emanate from the State University of New York College of Medicine of New York City; the Kessler Institute, West Orange, N.J.; the Sloan-Kettering Institute; Memorial Center for Cancer and Allied Diseases, New York; Georgetown University Hospital, Washington, D.C.; University of Pennsylvania School of Medicine, Philadelphia, Pa.; and Johns Hopkins Hospital, Baltimore, Md.

■ A weekly series of 40 television programs dealing with vital problems in the fields of medicine and community health will be telecast beginning this fall over Station WGBH-TV, Boston, Mass., as a result of an educational grant made jointly to Harvard University and the Lowell Institute by the John Hancock Mutual Life Insurance Co. The series, entitled *The Facts of Medicine,* will originate in the department of preventive medicine at the Harvard Medical School. The first program will be presented on 6 Oct. at 8:30 p.m.

The selection of medical topics and their treatment as significant matters of public interest will be the responsibility of David D. Rutstein, head of the department of preventive medicine. The purpose of the series will be to provide accurate, up-to-date, and useful information about the newer developments in medical research and their applications.

■ *Frontier to Space,* a new series of 26 programs dealing with the fundamentals of rocketry and space exploration, has been accepted for national distribution by the Educational Television and Radio Center, Ann Arbor, Mich. The series was released the week of 18 Sept. and is available to all 14 educational television stations now broadcasting.

Intended to acquaint viewers with the basic problems of jet propulsion and the capabilities and limitations of rockets in their present state of development, the series was produced by the physical science laboratory of the New Mexico College of Agriculture and Mechanical Arts. Two of the programs deal with the development and the reasons for launching artificial earth satellites.

The series features discussions of rocketry by an authority on upper air research, R. K. Sherburne of the physical science laboratory of New Mexico A. and M. Sherburne is narrator for all 26 programs, which include demonstrations of rocket launching.

Frontier to Space was filmed with the assistance of the White Sands Proving Ground in Fort Bliss, Tex.; the Applied Physics Laboratory of Johns Hopkins University; the Naval Research Laboratory; the Upper Air Research Center of Sunspot, N.M.; and Holloman Air Force Base. Producers of the show are Paul Rader and Fred Lawrence and the director is Joe Lacovic. The Educational Television and Radio Center later will offer *Frontier to Space* to schools, colleges, and universities and other community organizations through its extended services program.

■ A survey of the scientific literature on radiation sterilization is contained in four Federal Government research reports recently made available to industry by the Office of Technical Services, U.S. Department of Commerce. The reports were prepared by Quartermaster Food and Container Institute for the Armed Forces.

Experimental treatment of foods such as meat, dairy products, vegetables, and flour with low doses of radiation has resulted in extended storage life of the foods. Meat can be stored for several weeks after such treatment. The radiations also serve as growth inhibitors that eliminate or delay potato and onion sprouting.

Reports and Letters

Simple Method for Histochemical Detection of Esterase Activity

Several methods (*1*, *2*) have already been proposed for the histochemical demonstration of esterase activity. For acetylcholinesterase in the nervous system, the acetylthiocholine method of Koelle and Friedenwald (*2*) seems to be the most histologically accurate as well as biochemically specific. Unfortunately, the substrate is expensive and the procedure is hazardous (*3*).

On the other hand, the mechanism of enzymic hydrolysis has been studied thoroughly (*4*). Acetylcholinesterase has been shown to contain an anionic site capable of binding the cationic portion of acetylcholine and similar molecules and also an esterasic site upon which the enzymic activity is directly dependent. The theory involves an acetylated enzyme as intermediate. On this basis, it has been demonstrated that acetylcholinesterase catalyzes the hydrolysis of thiolacetic acid with liberation of acetic acid and hydrogen sulfide (*5*). The undissociated acid molecules are the direct reactants. The rate of reaction falls off rapidly with increasing *p*H and in the presence of prostigmine. This reaction could be the basis of a histochemical test for esterase, the evolved H_2S to be trapped *in situ* by either lead nitrate or acetate, thus forming a precipitate in areas of enzymic activity.

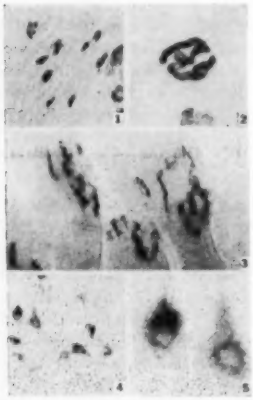

Fig. 1. Bouquet of motor end plates in the rat's tongue. Counterstained with basic fuchsin (×100). Fig. 2. Motor end plate in rat's tongue (×350). Fig. 3. Superficial arborization in frog's gastrocnemius. Glycerogel mount, unstained (×117). Fig. 4. Neurons of the dentate nucleus, cerebellum of rat. Formalin fixed, unstained (×100). Fig. 5. Two cells from the dentate nucleus (×350).

The tongue and central nervous system of the rat and also the gastrocnemius muscle of the frog were the objects of investigation. Portions of tissue 2 to 3 mm thick were either frozen immediately or prefixed overnight in 4-percent neutral, isotonic formaldehyde at 4°C, before freezing. Sections of 10 to 20 μ were mounted from saline onto clean glass slides precoated with 1-percent egg albumen in distilled water. They were dried rapidly with an electric fan or slowly by vacuum desiccation over $CaCl_2$ at 4°C, so that they became solidly attached to the glass slide and also that autolysis could be prevented.

The incubation medium was prepared extemporaneously by dissolving thiolacetic acid (0.12*M*) and lead nitrate (0.001*M*) in 83 ml of Na_2HPO_4 (0.1*M*) and adding 17 ml of McIlvaine phosphate-citrate buffer at *p*H 6.2.

The dried sections were placed in the incubation bath for periods of 30 to 60 minutes at room temperature. They were then washed for 5 minutes in slow-running water at 4°C. The rat tongue was counterstained 8 to 10 minutes in 0.02-percent basic fuchsin, then dehydrated rapidly in one bath of 95-percent alcohol and three baths of 100-percent alcohol. When counterstain was not used, the sections were passed through 80-percent alcohol and then through 95- and 100-percent alcohol. All sections were then cleared in three baths of xylene and permanently set in Permount (Fisher). Some were mounted in glycerogel from water. Other counterstains such as safranin were tried; they must be avoided because they destroy the integrity of the lead sulfide image or its support.

The results have been constant with each type of tissue utilized. Photomicrographs have been taken at different magnifications to illustrate various features. In the rat tongue at low power (Fig. 1), the reliability of the procedure is demonstrated on a group of adjacent motor end plates. The reticular appearance of the individual plate and its clear central channel reported by Couteaux after staining with Janus Green B (*6*) have been reproduced by this histochemical procedure (Fig. 2). The superficial arborization of the frog muscle has been well demonstrated also (Fig. 3).

In the formalin-fixed central nervous system of the rat, the precipitate occurred regularly along certain fiber tracts but especially over the neurons. These were grouped into four categories in relation to intensity: (i) least intense, the pyramidal cells of the cerebral cortex; (ii) the Purkinje cells of the cerebellum; (iii) the motor neurons of the spinal cord; and, most intensely reactive, (iv) the dentate nucleus of the cerebellum (Figs. 4, 5), the red nucleus, the motor nucleus of the fifth nerve and the diffuse nucleus of the pons. In individual cells, the precipitate occurred over the cytoplasm and along the proximal processes (Figs. 4, 5). The nucleus was always negative. Often a perinuclear localization of the precipitate was observed (Fig. 5).

Formalin fixation, as applied, did not seem to decrease the intensity of the reaction in the rat tongue, but it produced granulation and changes in the morphology of the motor end plate, as compared with the unfixed specimens. No image was obtained in frog muscle after fixation; only a diffuse, generalized precipitate was obtained.

Preincubation in prostigmine bromide ($10^{-6}M$) and also in tetraethylpyrophosphate at ($10^{-7}M$) have inhibited completely the activity of the motor end plate in the rat tongue, while a nonspecific esterase active site in the surface epithelium was still present after 15 minutes in either one of these inhibitor solutions.

It is proposed that this precise, constant, simple, and inexpensive procedure can be utilized, along with specific inhibitor control, for histological investigations and also for physiological, pharmacological, and pathological studies involving cholinesterase (*7*).

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3 June 1955

Lysine and Cariogenicity of Two Experimental Rat Diets

Smooth surface dental caries in white rats resulted from a diet containing heat-processed cereal foods (*1*) and also from diets containing commercial roller- and spray-process skim-milk powders (*2*). An additional "dry autoclaving" of both roller-dry and spray-dry skim-milk powders augmented their cariogenic property (*2, 3*). The more severe the heat treatment during preparation of skim-milk powders, the greater the apparent cariogenic effect in rats' diets (*4*).

In these previous experiments, growth failure resulted from feeding both diet 586 (*1*) and diet 636 (*2*), but growth was greatly improved by a lysine supplement. A deficiency of lysine in diet 586 was due to its cereal content as well as to an additional heat treatment of the cereal foods (*5*). Lysine was inadequate in diet 636, because of the dry autoclaving of the milk powder (*6*). The effect of lysine on the cariogenic potential of these diets thus became a matter of great interest, and this report presents current results from this continuing experimentation (*7*).

The general plan of this kind of caries study, as well as the preparation of the diets, is described elsewhere (*1–3*). The rats were of Holtzman and Sprague-Dawley strains from the National Institutes of Health. The dental caries was essentially all the smooth surface type, although considerable occlusal fissure caries, along with smooth surface caries, has been observed by other investigators who have fed diet 636 (*8*). Mixed thoroughly into the dry ration, lysine was the only variable in the test versus control diets. Weanling-age litter-mate rats distributed equally according to sex were compared on control and test diets for either 60 or 90 days. In most of these studies, food allotments of pairs (in one instance tetrads) of control and test rats were equalized. The pertinent data are presented in Table 1.

In the first of these studies (diet 586, Table 1) a supplement of 2.5-percent DL-lysine accounted for a significant reduction in both incidence and severity of caries. Following these initial studies major interest centered on diets containing skim-milk powders (*3, 4*) including diet 636, which was lysine deficient. These results have proved especially interesting because a notable reduction in caries occurred on the addition of L-lysine to diet 636. This reduction was consistent in 10 comparisons of diet 636 fed with and without L-lysine supplement (Table 1). On the average, L-lysine reduced caries approximately 59 percent in incidence, 78 percent in number of carious teeth, and 83 percent in severity score.

To throw further light on the possible specificity of L-lysine as an anticaries agent in diet 636, L-arginine monohydrochloride (0.5 percent) and L-histidine monohydrochloride (1.0 percent) were added independently to diet 636. Some loss of these two basic amino acids occurred when skim-milk powder had been dry autoclaved (*9*). However, no inhibition of caries resulted from these two supplements. Additional experimentation also compared L-lysine monohydrochloride with D-lysine monohydrochloride, L-ornithine monohydrochloride, and cadaverine dihydrochloride, which were added independently at a level of 0.25 percent to diet 636. This study evaluated compounds similar to L-lysine in composition and structure, for speculation on this entire problem had considered the possibility that free L-lysine, per se, might have an anticaries effect independent of its nutritional requirement. Related compounds, therefore, might have a similar anticaries property. Whereas L-lysine was highly inhibitory of caries, D-lysine had no effect on caries and, as was expected, did not promote growth. Neither did ornithine nor cadaverine inhibit the caries produced by diet 636.

In view of the striking reduction in the cariogenicity of diet 636 by L-lysine and of diet 586 by DL-lysine, similar studies with diet 635 were undertaken. Although this latter diet contains unautoclaved milk powder and is not deficient in lysine, insofar as may be indicated by its ability to support growth, it nevertheless has proved to be distinctly cariogenic (*2, 3*). Thus far the addition of L-lysine to diet 635 at levels of 2.00 and 2.50 percent has given somewhat variable results. The data indicate strongly that L-lysine does not significantly inhibit the smooth surface caries produced by this diet, which may possibly be reconciled by the fact that it is adequate in lysine. This result does not support the idea that free L-lysine, per se, has anticaries properties, but it does suggest that the cariostatic effect of L-lysine is somehow dependent on its dietary deficiency, at least as produced during heat processing of a skim-milk powder.

Although the cariogenic potential of a diet containing dry autoclaved skim-milk powder was greatly inhibited by as little as 0.25-percent L-lysine, this does not justify the conclusion that a lysine deficiency alone causes the cariogenicity of this diet. A combination of the complex changes identified with heat processing of milk powders may be involved. On the other hand, it is of interest to note a recent report in which degenerative changes in incisor dentine, alveolar bone, and the mandibular condyle of rats are attributed to a dietary deficiency of lysine (*10*). Additional studies are required to determine whether the lysine deficiency of diet 636 has a similar adverse effect on rats' dental structures and whether the defects are related to the caries. In control and L-lysine-supplemented pairs of rats, in which food allotments were equalized, caries reduction was not related to the growth-promoting effect of L-lysine.

Table 1. Effect of a lysine supplement on the smooth surface rat caries produced by diets 586 and 636

L-Lysine added* (%)	Rats (No.)	Daily gain (g)	Carious rats (%)	Carious teeth per rat	Severity score
		Diet 586			
0.00	45	0.3‡	62.2	1.7	5.0
2.50†	59	0.5‡	18.6	0.5	0.8
		Diet 636			
0.00	37	1.0‡	89.2	3.5	8.4
2.50	37	1.2‡	51.4	1.3	2.0
0.00	40	0.7‡	60.0	1.3	2.1
2.00	38	1.0‡	7.9	0.1	0.2
2.00	39	1.8	23.1	0.4	0.6
0.00	38	0.6	92.1	6.4	21.3
2.00	37	1.5	78.4	1.5	4.1
0.00	16	0.5‡	87.5	4.4	11.6
2.00	19	0.7‡	42.1	0.6	0.8
0.00	38	0.6‡	94.7	4.6	10.5
1.50	34	1.0‡	32.4	0.9	1.3
0.00	34	0.9‡	82.4	3.3	6.9
0.25	36	1.1‡	61.1	1.6	2.7
0.00	43	0.3‡	83.7	2.6	5.4
0.25	43	0.4‡	20.9	0.5	0.8
0.50	44	0.5‡	20.5	0.4	0.6
2.50	44	0.5‡	9.1	0.2	0.3

* Fed as the monohydrochloride. † DL-lysine monohydrochloride. ‡ Food allotment of paired control and test rats was equalized.

The inactivity of arginine and histidine strongly suggests that a deficiency in lysine is at least one basic cause of the caries potentiality of diet 636. The specificity of L-lysine as a compound having caries-inhibitory effects in diet 636 is also supported by the evidence that D-lysine in particular, as well as ornithine and cadaverine, failed to reduce the caries produced by this diet.

Continuing studies will attempt to resolve some of the questions raised by these latest results and particularly to clarify the possible role played by L-lysine. The properties of these cariogenic experimental diets permit somewhat new approaches to the resolution of the possible relationship of dietary factors to the etiology of dental caries.

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7 June 1955

Interaction between Oxygen and Oxygen-Carryng Proteins

In a recent article I. M. and T. A. Klotz (*1*) state that they have elucidated the nature of the electronic changes responsible for color and the oxygen-carrying ability of certain metal-proteins. Inspection of the observations and deductions of these authors leads to a somewhat different impression.

The article (*1*) starts with a summary of earlier studies of hemocyanin, a copper-containing protein that carries oxygen. Although the general inference is drawn that the protein contains cuprous copper, it is correctly stated that the evidence from magnetic and spectrophotometric data, as well as from the experiments of the authors on the oxidation-reduction potentials of the protein, is inconclusive. Some chemical evidence is then discussed. The experiments were carried out by the authors in the following fashion. Hemocyanin and oxyhemocyanin were separately prepared, and the copper content of the proteins was estimated by means of diquinolyl, a reagent for cuprous copper. A separate experiment was made so that the total copper content of the protein was known. Then, the authors continue, the difference between total copper content and copper content determined by diquinolyl gives the content of cupric copper.

Two points deserve consideration here. First, the reaction with diquinolyl is not instantaneous, on the authors' evidence, and no proof that the reaction goes to completion is given. It is less likely to go to completion with oxyhemocyanin than with hemocyanin, for the copper is bound with much greater affinity in the oxyhemocyanin. Diquinolyl can act only as a competing ligand for cuprous copper against the protein and oxygen, assuming, as the authors do, that there is a direct oxygen-copper bond, and it seems more reasonable to assume that the reagent fails to extract all the coppen than to assume that all it fails to extract is cupric ions. Klotz and Klotz do not test for cupric ions. If their assumptions are allowed, however, the conclusion is reached that half of the copper is as cupric and half as cuprous in the oxyhemocyanin. (In passing it should be observed that the figure of a half is derived from a comparison of the cuprous content of hemocyanin and of oxyhemocyanin, but the latter is only 39 percent of the *total* copper in the protein.) Surely, on removal of the cuprous copper from the oxygenated protein, the oxygen must be released, especially if the stability of the oxygen complex depends on the structures given. But the uptake of oxygen is reversible in the protein, and release of oxygen should lead to the "cupric" ions of oxyhemocyanin reverting to cuprous. Klotz and Klotz do not observe this. Does their procedure irreversibly oxidize the cuprous ion?

Turning next to hemerythrin, the authors present an identical argument. This protein is iron-containing, and the estimation of the ferrous and ferric content is made by use of phenanthroline, which gives a color with ferrous ions. No color developed in the reaction between the reagent and oxyhemerythrin; therefore, state Klotz and Klotz, all the iron is in the ferric state. The more likely conclusion is that the phenanthroline extracted no ferrous iron from the protein. The authors do not test for ferric ions. In hemerythrin itself about two-thirds of the iron was found to be ferrous by this phenanthroline "test."

If it is allowed that Klotz and Klotz have established a case for mixed valence states in the oxygen-containing proteins, then some of the structures proposed by them can be considered. At this point, however, the authors confuse two models. One is of the type discussed by McConnell and Davidson (*2*) in the mixed valency complexes, such as $Cu(II) \cdot Cl^- \cdot Cu(I)$ in solutions of which both cuprous and cupric ions could be detected, and the other is the no-bond complexes in which also charge-transfer forces play a part, for example, $Cu(I) \cdot O_2 \cdot Cu(I)$. Contribution to the stability of the latter type of complex is made by the structure $Cu(II) \cdot O_2^- \cdot Cu(I)$, but cupric ions are not detectable by chemical tests. These charge-transfer structures for oxygen-carrying proteins are contained in Pauling's and Mulliken's descriptions of double bonding in the transition metal complexes with unsaturated ligands and have been discussed with regard to hemocyanin (*3*). The evidence cited by Klotz and Klotz does not elucidate these matters.

Finally, turning to the absorption spectra of the oxygen-carrying proteins, the following observations are worth note. Ferrous and cuprous ions form complexes with aromatic diimines, which have very similar absorption spectra. The characteristics of these spectra have been explained on the assumption that the excitation involves the partial transfer of electrons from the cation to the ligand (*4*). Very similar absorption bands are found in certain cobaltous complexes. All three cations in other complexes appear to be able to carry oxygen, but the ferrous and cobaltous complexes do so only if, on the uptake of oxygen, there is a change in paramagnetic moment. Simultaneously with the change in paramagnetic moment, there is a large change in the absorption spectra of the complexes. This change in absorption is so like that described by Klotz and Klotz in hemerythrin on oxygen uptake that it is tempting to conclude that hemerythrin is a ferrous protein and paramagnetic but that it becomes diamagnetic on uptake of oxygen. It is also a mistake, on the evidence available, to assume that the absorption spectrum of oxyhemocyanin is not that of a cuprous protein (*1*) and (*3*). Many cuprous complexes do absorb strongly in the near ultraviolet, and many others have absorption bands in the visible. The final word on the electronic states of the oxygen-carrying proteins has not been said.

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27 May 1955

The heart of R. J. P. Williams' criticisms of our paper is based on an incorrect reading of our actual experimental procedure in carrying out chemical tests for the valence state of copper in hemocyanin and of iron in hemerythrin.

Let us consider (oxy)hemocyanin first. The actual procedure consists of adding a solution of biquinoline in glacial acetic acid, *the acid serving as an agent for the release of protein-bound copper*, to a small portion of oxyhemocyanin. A pink color develops instantly, although there are small changes over a period of a few minutes. The intensity of light absorption is measured. Thereafter a reducing agent, hydroxylamine or ascorbic acid, is added *to the same test tube*. The intensity of the pink color increases immediately, and a second absorption measurement is made. If, as Williams claims, the first reading is low because not all of the copper has been released from the protein, why is the reading increased approximately twofold when a minute amount of hydroxylamine is added? From this experiment alone it seems difficult to believe that the biquinoline fails to complex all the cuprous ion present. Furthermore, as a letter of inquiry would have established, we used higher biquinoline concentrations also and obtained the same answers. Finally, as an examination of the literature would have shown, the copper of hemocyanin becomes dialyzably free in acid solution.

Turning to hemerythrin, essentially the same answer applies. In this case we added a solution of *o*-phenanthroline in dilute *sulfuric acid* to a small portion of oxyhemerythrin. Essentially no color developed (if a small amount of fluoride ion was added to complex ferric ion, no color at all appeared). Thereafter hydroxylamine (a reducing agent) was added *to the same test tube*. A deep orange color developed immediately, although it changed more slowly toward its asymptotic final reading. If, as Williams claims, the first reading is low because not all the iron is released from the protein, why is the reading increased to full value when a minute amount of hydroxylamine is added? From this experiment alone it seems difficult to believe that the phenanthroline fails to complex any ferrous ion present. Furthermore, as an additional test of complete removal of iron from the protein, we carried out a number of experiments at different acidities and found no effect over an appreciable *p*H range. Finally, as an examination of the literature would have shown, the iron of hemerythrin becomes dialyzably free in dilute acid solutions.

There are also certain secondary points raised by Williams' communication. With regard to the state of the released oxygen in hemocyanin, there is no reason for his stating categorically that in strong acid molecular oxygen goes off. As was clearly implied in our paper, it might be released as a hydroperoxide ion, O_2^-, or as HO_2. Some experiments in this direction would be more in order, and we have carried them out. With regard to the fraction of Cu(I) in oxyhemocyanin, the appropriate figures to take from Table 1 of our paper, for reasons listed there, are $2.9 \times 10^{-4} M$ and $6.5 \times 10^{-4} M$, which lead to a fraction of 45 percent, instead of the 39 percent cited by Williams. Within the precision of the analyses, 45 percent seems sufficiently close to justify the "approximately one-half" that we stated.

The statement that we are confusing two models in connection with our Fig. 3 is unwarranted. We have proposed as an analogy only the mixed valency complexes $Cu(II) \cdot Cl^- \cdot Cu(I)$. The insertion of charge-transfer forces is Williams' contribution.

Finally, the analogy between the ferrous (or cuprous) complexes with aromatic diimines and hemerythrin (or hemocyanin) may or may not be useful. If one starts from the premise, as Williams has, that these proteins contain no-bond complexes, then it becomes desirable to point to excited states involving charge-transfer complexes. However, in the light of our chemical data, it is difficult to see how one can maintain such a premise. In any event, any model of these oxygen-carrying proteins must account for the mixture of valence states of the metal ions released from the oxygenated or nonoxygenated form. Our model does so; the no-bond model does not.

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1 August 1955

Effect of Insulinase-Inhibitor on Hypoglycemic Action of Insulin

Utilizing the release of iodine-131 from I^{131}-labeled insulin as an index of insulin degradation, it has been demonstrated that exogenous insulin is destroyed by the intact animal (*1*), just as it is by homogenates, extracts, and slices of liver and other tissues (*2–4*). This destruction appears to be due to the action of an enzyme system, insulinase, that is relatively specific in catalyzing the hydrolysis of insulin (*5*). The subcutaneous or intraperitoneal injection of a nonprotein liver fraction that inhibits the *in vitro* inactivation of insulin by homogenates (*6*) and slices (*3*) of liver is effective also in inhibiting the degradation of I^{131}-labeled insulin by the intact animal (*7*). The active component of the liver fraction is tentatively referred to as "insulinase-inhibitor."

Table 1. Effect of liver insulinase-inhibitor on fasting blood glucose concentration (expressed as mean ± standard error)

Injection	Before (mg/100 ml)	After 1 hr (mg/100 ml)
Saline	81.7 ± 2.1	78.7 ± 1.8
Inhibitor	76.2 ± 2.2	77.4 ± 1.2

In order to establish that the inhibition of insulin degradation *in vitro* is associated with an increase in the biological activity of insulin, the effect of a crude preparation of liver insulinase-inhibitor on the hypoglycemic action of exogenous insulin was determined in rats and rabbits (*8*).

The crude insulinase-inhibitor was prepared as follows: 100 g of fresh beef liver was homogenized with 1000 ml of water, and the *p*H was adjusted to 4.8 with hydrochloric acid. The homogenate was boiled for 10 minutes and was filtered, and the filtrate was dried by lyophilization. The lyophilized product was extracted with 20 vol of glacial acetic acid, and the acetic acid filtrate was precipitated with 3 vol of cold acetone. The precipitate was washed with acetone and dried with ethyl ether. The dried precipitate was dissolved in water and adjusted to *p*H 7.0. This preparation inhibited the action of insulinase *in vitro* and *in vivo*, as measured by the inhibition of the release of I^{131} from labeled insulin.

Four groups of 12 male rats of the Carworth strain were used after an overnight fast. The rats weighed from 200 to 275 g. Blood samples were taken from the cut tail, and the concentration of glucose was determined by the Nelson procedure (*9*). After a preliminary blood sample had been taken, two groups of rats were given a subcutaneous injection of 6 ml of a 10-percent solution of the liver preparation per 100 g of body weight, and the other two groups were given a similar volume of saline. One hour after the subcutaneous injections, a second blood sample was taken. Then one control group and one experimental group of animals were given an intraperitoneal injection of 0.5 unit of insulin per kilogram of body weight, and the other control and experimental groups were given 1.0 unit of insulin per kilogram of body weight. Thereafter, blood samples were taken at hourly intervals for 4 hours.

The subcutaneous injection of the liver insulinase-inhibitor preparation produced no significant change in the concentration of the blood glucose (Table 1).

However, the hypoglycemic action of the insulin injected 1 hour after the liver preparation was markedly increased. This statistically significant ($P < 0.001$ at 2, 3, and 4 hours after 0.5 unit/kg of body weight and $P < 0.05$ at 3 hours and $P < 0.01$ at 4 hours after 1.0 unit/kg of body weight) effect is illustrated in Fig. 1, where the blood glucose concentration is expressed as a percentage of the preinjection level.

Whereas the insulinase-inhibitor preparation was nontoxic for rats even at a dosage of 10 g/kg of body weight, it was toxic in rabbits at dosage levels as low as 1 g/kg of body weight. Occasional rabbits survived the subcutaneous injection of 1 or 2 g of the preparation per kilogram long enough to permit the determination of the hypoglycemic response to the intravenous injection of 0.1 unit/kg of body weight. Figure 2 illustrates the hypoglycemic response of a rabbit that lived about 18 hours after the subcutaneous injection of a solution containing 2 g of the preparation per kilogram of body weight.

In this experiment, the hypoglycemic response to the intravenous injection of insulin was tested in two rabbits. After a preliminary test in which both rabbits gave essentially the same response, one animal was given a subcutaneous injection of saline and the other an injection of the liver extract. One hour later, the hypoglycemic response to the intravenous injection of insulin was determined again. It is apparent that the injection of the insulinase-inhibitor preparation 1 hour before the insulin resulted in a marked increase in the biological effectiveness of the insulin. Similar results have been obtained with other rabbits that survived the injection of the liver preparation.

The data reported here reveal that a liver insulinase-inhibitor preparation that

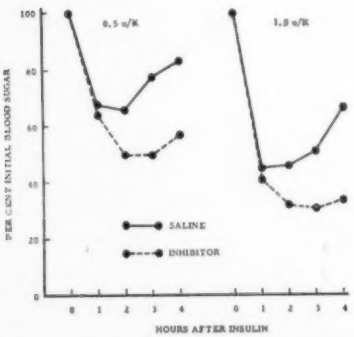

Fig. 1. Effect of insulinase-inhibitor on hypoglycemic action of insulin in rats. Response expressed as percentage of the blood sugar concentration immediately before the intraperitoneal injection of insulin.

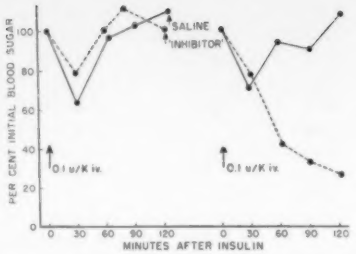

Fig. 2. Effect of insulinase-inhibitor on hypoglycemic action of insulin in rabbits. Two rabbits were given an intravenous injection of insulin at zero time. A second injection of insulin was given 1 hour after the subcutaneous injection of either saline or liver preparation. Response expressed as percentage of the blood sugar concentration immediately before each intravenous injection of insulin.

effectively inhibits the destruction of insulin *in vitro* and *in vivo* is effective also in increasing the biological activity of insulin in rats and rabbits.

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16 May 1955

Prenatal Ingestion of Fluorides and Their Transfer to the Fetus

McKay and Black have pointed out that factors influencing the integrity and structure of tooth enamel are effective only during the calcification period (*1*). It is logical then to assume that any beneficial effects from fluorides would be derived only while the teeth are in developmental stages when the matrix is being formed and the enamel is undergoing calcification or maturation.

On this premise, a long-range study was instituted in 1948 to determine the value of fluorides in preventing caries. The fluorides are given to the expectant mother during pregnancy and are also administered to the child until permanent tooth calcification has occurred (*2*). A final report of this work will not be made until the teeth of the offspring can be evaluated for their resistance to decay. This paper, a phase of the study, presents the results of an investigation to determine the relationship between maternal ingestion of fluorides, placental storage, transplacental passage, and fetal cord blood levels.

Past studies have mentioned the transfer of fluorides from mother to fetus (*3*) and have shown a positive correlation between fluoride supplementation and the fluoride content of the placenta (*4*). However, there is no report in the literature of an attempt to correlate the fluoride concentration of fetal blood and placental tissue in a study using fluoride tablets during the pregnancy.

Four groups of patients were used: (i) patients given one tablet of calcium fluoride (each 2 mg) (*5*) or sodium fluoride (each, 2.2 mg) per day. Treatment was initiated at various stages of pregnancy; (ii) controls, from the same locale, who had no known supplemental fluorides; (iii) individuals who drank artificially fluoridated water throughout their pregnancy; and (iv) controls from a nearby area that did not have a fluoridated water supply.

Sections of approximately 25 g of tissue were taken from the periphery of the placenta, and about 25 to 50 ml of blood was expressed from the umbilical cord after it had been severed. The fluorides were then separated by the Willard-Winter distillation (*6*) process and their concentration was determined by the William's titration method as modified by Smith and Gardner (*7*). Every possible precaution was taken to rule out any laboratory error. A constant and a percentage correction factor, as well as the standard deviation of 2.4 percent of the technique, were considered before the results given in Table 1 were reached.

The average fetal blood fluoride concentration in the tablet study group was 41 μg/100 ml; in the control, 17 μg/100 ml. The average placental fluoride concentration in the tablet study group was 111 μg/100 g; in the control, 101 μg/100 g.

In the fluoridated water supply study group, the average cord blood concentration was 38 μg/100 ml; in the control, 22 μg/100 ml. The average placental concentration was 85 μg/100 g in the study cases; 68 μg/100 g in the control.

In both study groups the average cord blood fluoride concentration was higher than it was in the respective controls. The concentration in the group that took fluorides by tablet was 250 percent higher than it was in the control; in the group that took fluoridated water, the concentration was 175 percent higher. Twenty percent of the tablet study group had a

Table 1. Fluoride concentration in cord blood and placenta

Group	No. of cases	Average fluoride concen.	
		Cord blood (μg/100 ml)	Placenta (μg/100 g)
Fluorides by tablet	20	41	111
Control	146	17	101
Fluorides from water	6	38	85
Control	9	22	67

fluoride concentration above 50 μg/100 ml, whereas only 3 percent of the control group had a concentration above this level.

This marked difference between the fluoride concentrations of the control and the study groups was not shown in the placentas. However, it is important to note that in neither study group was there any placental concentration of less than 25 μg/100 ml. But in the tablet control group, 7.5 percent contained less than this concentration, and in the fluoridated-water control, 11 percent contained less.

The large difference in the placental fluoride concentration in the two control groups may be explained by considering the amount of fluorides ingested in the normal diet in the two localities.

The role of the placenta in fluoride metabolism remains obscure. Two placentas, one from the tablet control group and one from the tablet study group, were selected at random and analyzed completely by sections for their fluoride content. The results are represented diagrammatically in Fig. 1. In both cases the fluorides were more concentrated in the periphery of the placentas. The reason for this distribution is not apparent at this time but two possible reasons can be offered. (i) Since the calcium content of the placenta is relatively high at the periphery (*8*), the distribution may be merely a chemical manifestation. (ii) The placenta may serve as both a storehouse and a regulator of the fluorides. In an attempt to prevent too much fluoride from entering the fetal blood stream at one time, the placenta pushes it away from the area of most active maternal-fetal exchange. In the periphery, the fluorides are stored and released as needed. Scant proof of this hypothesis may be found in the observation that the difference in the placental fluoride concentration between the study and control groups was not marked in either locality.

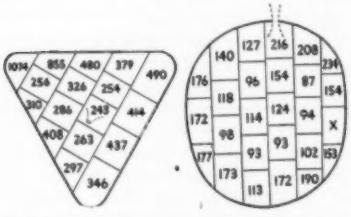

Fig. 1. Fluoride content of placenta: left, tablet study (average, 419 μg of fluorine per 100 g of tissue); right, tablet control (average, 141 μg of fluorine per 100 g).

The results of this study indicate that the fetal blood level can be increased by supplementation either in tablets or in water; however, the importance of this is difficult to assess at the present time because there is no known normal or optimum concentration. Besides an increased fluoride concentration in both the cord blood and the placental tissue of the study cases, no other correlation was demonstrated.

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26 May 1955

To Calculate Days between Two Dates

G. J. Cox [*Science* **121**, 779 (1955)] has presented a section of a counting house calendar for estimating intervals in days. A useful table for this purpose is found in *The World Almanac and Book of Facts*, which is published annually by the *New York World-Telegram and Sun*, a reference within easy reach of most laboratory workers. The table "Days between two dates" appears on page 412 of the 1955 edition. The arithmetic of the table is obvious.

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7 June 1955

The reference to the development of a calendar of "days elapsed" and "days remaining" by G. J. Cox is of more than passing interest. Such information is desired quickly in many fields of work. In our work we are constantly involved in a variety of problems that are simplified by the use of such a calendar.

However it is strange that so many scientists, engineers, and others are unaware of the simplest calendar of all—the Julian Day calendar—which enables Cox's example to be done by mental arithmetic, subtracting one number from another. For example, the Julian Day number is represented by seven figures and 1 Jan. 1951 is J.D. 2433647. However, usually only the last three or four figures are necessary.

30 Jan. 1955 = J.D. - - - 5138
28 Dec. 1951 = J.D. - - - 4009

Age in days 1129

There is no need to worry about leap year. We use a standard 100-year table showing the Julian Day number for the first day of each month from 1900 to 2000. One of the most widely distributed is the AAVSO Julian Day calendar, which has been produced for many years by the American Association of Variable Star Observers. The AAVSO J.D. calendar for 1955 was printed by the United Scientific Co., for the AAVSO and distributed by both organizations. The American Ephemeris also includes a summary J.D. calendar covering the period A.D. 0 to A.D. 2019 for use where longer periods of time are required. The J.D. calendar deserves a more widespread use, for it eliminates a lot of mental and physical effort, and answers all of Cox's problems.

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16 June 1955

"Science carries us into zones of speculation, where there is no habitable city for the mind of man."—ROBERT LOUIS STEVENSON.

Book Reviews

Thomas Bradwardine His Tractatus de Proportionibus. Its significance for the development of mathematical physics. H. Lamar Crosby, Jr., Ed. and Trans. Univ. of Wisconsin Press, Madison, 1955. xi + 203 pp. $3.50.

The study of the history of science slowly is coming to be a recognized discipline in university instruction. There are at least three American institutions, Cornell, Harvard, and Wisconsin, that grant the doctorate in this field; and at the last named there has been an emphasis on research in the history of medieval science. The present work is another welcome product of the active group that has been working at the University of Wisconsin under the able leadership of Marshall Clagett.

Traditionally the origins of modern dynamics have been found in the work of Galileo, although it now is half a century since Pierre Duhem argued persuasively that the source should be pushed back two and a half centuries to the Buridan school at Paris. H. L. Crosby here proposes a backward shift of a few more years to the activities of Merton College at Oxford, and more especially to 1328, the date of Bradwardine's *De proportionibus.*

The reputation of Bradwardine, "Doctor Profundus," never has needed apologists. He was elected Archbishop of Canterbury about a month before he died of the Black Death in 1349; and Chaucer's Nun's Priest mentions him in the same breath with Boethius and St. Augustine. Histories of mathematics cite with respect Bradwardine's contributions to the study of star-polygons, continua, and proportions. Only quite recently, however, has the significance of *De proportionibus* for the history of physics been appreciated, for the language of the original Latin has been difficult and obscure to readers brought up on modern tongues and mathematical symbolism. Now the treatise is available in a handy form with Latin and English on alternate pages, together with notes and index and an excellent introduction of more than 50 pages. The book is photographically reproduced from typescript, but it is done with exceptional neatness and clarity.

The *De proportionibus* is perhaps the earliest treatise to propose a general law of physics the expression of which called for transcendental functions rather than simple direct or inverse variation. Aristotle had assumed that velocity of motion V is determined by a proportionality between motive force F and resistance R; but the older use of the word *proportion* (or *analogia*) was so general as to make it practically equivalent to the modern function concept. Natural philosophers consequently had argued for centuries whether Aristotle's proportion should be "arithmetic" (of the form $kV = F - R$) or "geometric" (that is, given by $kV = F/R$). Bradwardine refuted both of these forms as well as the hybrid $kV = (F - R)/R$, showing that they are inconsistent with other Aristotelian axioms of motion. (Aristotle had assumed that halving both the motive force and the resistance would leave the velocity unchanged; and he had denied that there can be motion if there is equilibrium between the motive forces and the forces of resistance.) Then, having "put to flight" these "fogs of ignorance, these winds of demonstration," Bradwardine stated his own law that "the proportion of the speeds of motions varies in accordance with the proportion of the power of the mover to the power of the thing moved" (p. 111). His exposition shows, in words rather than symbols, that he had in mind the exponential relationship $n^V = F/R$, where n is constant. Later Mertonians applied this type of function, not only to uniformly accelerated motion, but also to problems of variation in psychology, ethics, and even theology.

Crosby's "Introduction" is a perspicuous interpretation of the place of *De proportionibus* in the growth of science. Among other provocative theses, it is argued that the origins of modern science are to be found less in the vaunted *Platonic* movement than in Bradwardine's mathematical treatment of the *Aristotelian* principles of motion (p. 17). And again, Crosby holds that Bradwardine's association of force with instantaneous, rather than average, velocity led directly to the work of his successors on uniformly accelerated motion, and that in this respect the Mertonian kinematics "seems closer to the modern point of view" than the impetus theory of the Paris school (p. 52). Such bold suggestions may undergo subsequent modification, but they afford a far more challenging picture of the history of science than does the stultifying and discredited idea that dynamics was created single-handedly by Galileo.

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Morbidity in the Municipal Hospitals of the City of New York. Report of an exploratory study in hospital morbidity reporting. Marta Fraenkel and Carl L. Erhardt. Russell Sage Foundation, New York, 1955. 229 pp. $4.50.

This work contains (i) a description of the procedures by which data on age, sex, race, marital status, religious affiliation, length of stay, diagnoses, surgical intervention, and condition on discharge were obtained for 121,952 patients discharged during May–October 1952 from 31 hospitals operated by the city of New York; (ii) 55 tables that mainly summarize data on the frequency of diagnosis in relation to one or more of the other aforementioned characteristics; and (3) general comments on the findings. In view of the kinds of hospitals studied, it is impossible to generalize the findings to all hospitalized patients in New York, let alone in other cities. The authors have wisely refrained from making any such generalizations.

The purpose of this "exploratory study" was "to test a plan for morbidity reporting." The test has apparently been considered successful, because the city of New York was able to obtain, process, and tabulate data from some of the hospitals it controls. It is surprising that a doubt existed about achieving this, especially when the authors state in the preface: "A morbidity reporting system of this kind has long been recognized as practicable for New York City but budgetary restrictions have prevented its establishment."

As reported here the study contributes little to the solution of the problems of measuring the incidence and prevalence of diseases in a community. Data on the characteristics of hospitalized patients are needed for this purpose, but until these data can be related to a well-defined population base and to nonhospitalized morbidity they are not very in-

formative. The contributions of this study to methodology are also limited, inasmuch as it was not designed to reveal how the nonmunicipal hospitals can be integrated into a community-wide reporting system and, most of all, because it was not designed to compare the several procedures that could be used for the several possible objectives of a community-wide hospital reporting system. Apparently the main contribution of this study is directed at the administrative problems of New York. In their foreword, the Commissioner of Health and the Commissioner of Hospitals write, "the study findings have been of great value to the operations of both departments."

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Introduction to Psychiatry. O. Spurgeon English and Stuart M. Finch. Norton, New York, 1954. viii + 621 pp. $7.

This is the first textbook of psychiatry to be completely oriented along psychoanalytic lines. The subject matter is covered in 592 pages with appended bibliography and index in 9 sections: "Concepts of dynamic psychiatry," "Child psychiatry," "Psychoneurotic disorders," "Personality disorders," "Psychophysiological disorders," "Functional psychotic disorders," "Organic brain disorders," "Mental deficiency," and "Therapy." The text is largely a compilation of lectures given to medical students, and each section is illustrated with well-chosen case material. The authors have attempted to follow the new revision of nomenclature of the American Psychiatric Association. This should be of help to board candidates in preparing for their examination. Psychoanalytic terms are briefly defined and easily memorized.

The theoretical approach is strictly Freudian, in that the authors adhere to the traditional description of libidinal stages of personality development from infancy to maturity. Neglect, however, to define specifically, to enumerate the variety of instincts, and to describe their state of fusion makes for a vague introductory orientation. In this connection, there is a tendency to neglect the importance of hereditary factors and to overemphasize environmental influence, which leads to a psychiatry without biological foundation and may result in a separation from the other branches of medicine. There is a lack of clarity, if not contradiction, in the discussion of the mechanisms of ego defense; for example, sublimation is said to be the only defense mechanism that can be considered well within the limits of normality, yet, of rationalization it is stated, "this mechanism of defense is one of the most common of all and is utilized to a certain degree by almost everyone."

Although the chapter on history taking and examination is extremely detailed, it is written so as to stimulate the medical student to develop and to use his intuitive endowment. The section devoted to child psychiatry neglects the importance today of juvenile crimes. However, it is clear, concise, well illustrated with case material, and devoid of repetition. Handling of the formal psychiatric disorders leaves little to be desired, and the therapeutic approach is eclectic. The manuscript was probably out of the authors' hands before the therapeutic value of the two new drugs chlorpromazine and reserpine was reported. The chapter on mental deficiency, although telescoped, is adequate as an introduction. The final section on therapy is constructively repetitious and includes an informative chapter on mental hygiene.

Despite my critical remarks, the book is a valuable textbook, not only to psychiatrists, but to physicians in other branches of medicine, to medical students, and to persons in related fields such as nursing, social work, psychology, and anthropology.

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of Physicians and Surgeons

Bibliography on Physical Electronics. Prepared by Wayne B. Nottingham and staff. Research Laboratory of Electronics, Massachusets Institute of Technology, Cambridge, 1954 (distr. by Addison-Wesley, Cambridge Mass.). iv + 428 pp. $8.50.

This publication is literally what the title suggests, a bibliography and no more. Completeness is a necessary attribute of such an offering, and I tested this by using spot checks. References on thermionic and photoelectric emission in the second edition of Dow's *Fundamentals of Engineering Electronics* were used, together with the references on semiconductor literature included in "The new electronics" by K. Lark-Horovitz, a chapter in the book, *The Present State of Physics,* and the *Abstracts of the Literature on Semiconducting and Luminescent Materials and Their Applications* (1953 issue) compiled by Battelle Memorial Institute.

The conclusion is that, while the bibliography is almost but not entirely complete, its 428 pages contain a large share of the references in the field and comprise a worth-while contribution. Many headings and subheadings are listed in the table of contents to assist in searching references. I prefer the format of the Battelle compilation for the brief abstracts that accompany each reference and for the paper-backed ring binding, which seems more appropriate for a book that is destined to become out of date so soon, but this is just a matter of taste.

The Nottingham bibliography and Battelle abstracts both eloquently demonstrate the magnitude of recent activity in the field of electronics.

B. R. GOSSICK
Department of Physics,
Purdue University

Atomic and Nuclear Physics. Robert S. Shankland. Macmillan, New York, 1955. xv + 529 pp. Illus. $7.75.

This book has been prepared from material used in a course for undergraduate physics majors and first-year graduate students. About half of the book is concerned with the topics usually described as "atomic physics"; there is a chapter on the solid state, and the remainder is on nuclear physics. A very wide range of topics is covered, including some rather up-to-date material—for example, on Lamb shift, antiferromagnetism, the transistor, nuclear magnetic resonance, production of elements up to $Z = 100$, nuclear chain reactors, and production and properties of mesons. Numerous subjects are described in historical development, and some of these stories are of the kind that will catch up the student in the excitement that is physics.

On the debit side, there are several features of the book that might leave one unhappy. For one, the treatments of certain basic concepts are wanting in carefulness and thoroughness. The Heisenberg uncertainty principle is discussed only briefly, although Brownian motion receives five pages. The terms ψ and *wave-function* are introduced without discussion, and without any mention of the Schrodinger equation; the term *parity* is used but not defined. Several topics suffer from the book's omission of any discussion of matrix elements or overlap integrals.

A second item concerns the referencing. A very large number of references is given to the original literature, but only in a few instances is the student referred to sources that might help him obtain the background necessary to understand the many sophisticated papers referred to.

A third shortcoming is the appreciable number of erroneous statements contained in the book. It is a difficult job to cover as wide a selection of topics as this book does and yet to avoid having some misstatements appear. Those noted in the material of a basic nature are the statements that Born's statistical interpretation is applicable to a system of many electrons only if their mutual interaction may be neglected, and that in the scattering of a pair of electrons, or protons, the interaction is purely the coulomb force for the case of antiparallel spins but greater for parallel spins.

On the whole, the book gives a survey of a broad range of phenomena that can be explained by the principles of quantum theory and a good discussion of many topics, including both basic ones and those of a more applied nature, but a student is not likely to be able to get from it by himself a thorough and solid understanding of the fundamental principles.

W. SELOVE
Physics Department, Harvard University

Supplement No. 2, 1955, of Cancer Research. *Negative Data from Experimental Cancer Chemotherapy Studies,* II. Various contributors. Univ. of Chicago Press, Chicago, 1955. 397 pp.

This supplement was published as a continuation of data presented in Supplement No. 1, 1953. Various contributors have supplied essentially experimental protocols in tabular form, with the briefest of textual explanatory notes, dealing with the failings of an imposing array of chemical compounds to affect experimental mouse and rat tumors. The editors state that the publication facilitates "earlier circulation of data, whether *positive* or *negative,* in order to prevent useless reduplication and to acquaint investigators of areas being explored by their confreres elsewhere." Unfortunately, some of the advantages of this type of publication have been overlooked by those contributors who refer to several previous publications of their negative findings.

Although the concept of printing a journal devoted to negative results may appear somewhat less than profound, the publication of such compilations in many fields might be appropriate and effective. This procedure would tend to relieve the already overburdened technical journals from publishing lengthy and formal articles reporting essentially negative findings, which are nonetheless of interest to workers in the specific field, and would present these results in brief but adequate, accessible form.—E. M. L.

Scientific and Technical Societies of the United States and Canada. National Academy of Sciences–National Research Council, Washington, ed. 6, 1955. 441 pp. $7.50.

Here is information on 1506 membership societies of a scientific or technical character in the United States, ranging from the Abilene Geological Society to the Zoological Society of San Diego, Inc. Similar information on 206 Canadian societies is also included. Information about each includes name and address, principal officers, history, purpose, membership qualifications and dues, size, time of meetings, research funds and medals if any, and publications.

The first such directory was published in 1908 by the Carnegie Institution of Washington. In 1927, by agreement, the National Academy of Sciences–National Research Council took over responsibility. This is the sixth directory under the NAS–NRC auspices. It differs from earlier ones in omitting institutions that do not have members. Information on the Canadian societies was compiled by the National Research Council of Canada; that on the United States by Callie Hull, librarian of the NAS-NRC, and her staff.

Directories of this sort are always useful. This one is particularly to be commended because of the up-to-dateness of the information (all obtained directly from officers of the listed societies in the latter half of 1954) and the detailed index of societies, publications, prizes and research funds, activities, purposes, and fields of science. There is a similar index for Canada.—D. W.

New Books

Electro-Magnetic Machines. R. Langlois-Berthelot. Trans. and rev. in collaboration with H. M. Clarke. Philosophical Library, New York, 1955. 535 pp. $15.

Introduction to Demography. Society of Actuaries' textbook. Mortimer Spiegelman. The Society, Chicago, 1955. 309 pp. $6.

Anti-Composition Tables for Carbon Compounds (CH, CHO, CHS, and CHOS). H. H. Hatt, T. Pearcey, A. Z. Szumer, compilers. Cambridge Univ. Press, London, 1955. 191 pp. $4.

Counseling in Medical Genetics. Sheldon C. Reed. Saunders, Philadelphia, 1955. 268 pp. $4.

Advances in Genetics. vol. VII. M. Demerec, Ed. Academic Press, New York, 1955. 309 pp. $8.

A Classification for Medical and Veterinary Libraries. Cyril C. Barnard. Lewis, London, ed. 2, 1955. 278 pp. £4, 4s.

A Handbook of Hospital Psychiatry. A practical guide to therapy. Louis Linn. International Universities Press, New York, 1955. 560 pp. $10.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or sponsoring agency.)*

Autohydrogenation of Oil Gases. Research Bull. 25, Inst. of Gas Technology. H. A. Dirksen, H. R. Linden, E. S. Pettyjohn. Illinois Inst. of Technology, Chicago, 1955. 75 pp. $5.

Memórias do Instituto Butantan, 1954. vol. XXVI. Instituto Butantan, São Paulo, Brasil. 318 pp.

Retailing and Wholesaling Cotton Planting Seed in Arkansas. Bull. 554. C. Curtis Cable, Jr. Agricultural Experiment Sta., Univ. of Arkansas, Fayetteville, 1955. 32 pp.

Notes on Shrimps from the Marshall Islands. Proceedings of the U.S. National Museum. vol. 105, No. 3349. Fenner A. Chace, Jr. Smithsonian Institution, Washington, 1955. 22 pp.

Thirty-Eighth Annual Report of the National Research Council of Canada, 1954–55 (in English and French). NRC No. 3607. The Council, Ottawa, 1955. 44 pp.

Observations sur la Genèse des Nappes de Gravats dans les Sols Tropicaux. Série Scientifique No. 64. J. de Heinzelin. L'Institut National pour l'Étude Agronomique du Congo Belge, Bruxelles, 1955. 37 pp. F. 30.

Facilities for Care of Experimental Dairy Animals. Special Rpt. 10. George G. Bateman. 12 pp. *Growing Alfalfa for Seed.* Circular 135. M. W. Pedersen *et al.* 60 pp. *Performance Testing Studies with Beef Cattle.* Bull. 337. James A. Bennett and Doyle J. Matthews. 15 pp. *Biennial Report of the Utah Agricultural Experiment Station 1952–1954.* Bull. 373. 62 pp. *Fertilizer Requirements of Alfalfa Hay in Utah.* Bull. 374. R. F. Nielson, J. P. Thorne, G. T. Baird. 15 pp. *Eradication of Mule Ear with Herbicides and Its Relation to Production of Forage on Range Lands.* Bull. 375. D. C. Tingey and C. Wayne Cook. 15 pp. *Potato Production, Utah 1953.* An economic analysis. Bull. 376. E. M. Morrison and W. G. Kearl. 26 pp. Agricultural Experiment Sta., Utah State Agricultural College, Logan, 1955.

Resultados Generales Referentes a la Descripción de un Foton en un Medio Material. A. Battig. vol. 10, No. 1–2, Ser. A, Revista. Matemática y Física Teórica. Universidad Nacional de Tucumán, Tucumán, República Argentina, 1954.

Tests for Type of Action of Hydrocarbon Insecticides Applied Jointly. Bull. 594. Neely Turner. Connecticut Agricultural Expt. Sta., New Haven, 1955. 23 pp.

Joint ILO/WHO Committee on the Hygiene of Seafarers. Second Rept. World Health Organization Technical Rept. Ser. No. 92. The Organization, Geneva, 1955. 20 pp. $0.30.

Eighteenth Semiannual Report of the Atomic Energy Commission. July 1955. GPO, Washington, D.C., 1955. 160 pp.

Second International Congress of the International Diabetes Federation. Cambridge, England, 4–8 July 1955. The Federation, The Hague, 1955.

Scientific Meetings

Importance of Seaweeds

The scientific and commercial importance of seaweeds was again emphasized when about 130 persons from 24 countries registered for the second international symposium at Trondheim, Norway, 14–17 July. The meeting was the result of a decision made at the first symposium held in Edinburgh in 1952. A third symposium is anticipated in Ireland in 1959. The remarkable international character of the gathering is indicated by the fact that delegates were present from such widely scattered countries as China, Japan, South Africa, Egypt, Iceland, the Faeröerne, Canada, and the United States as well as from European countries.

About 40 papers were presented, and most of them were of a chemical nature. Countries that would appear to be most active in this field are the United Kingdom, Norway, and Canada. The meetings were conducted almost exclusively in English. The sessions were held at the Norwegian Technical University under the general chairmanship of Trygve Braarud of the University of Oslo and were organized by the staff of the Norwegian Institute of Seaweed Research at Trondheim. The symposium lasted 3 days, and on two occasions separate sessions for chemical and botanical communications were held.

Papers of chemical interest included the description of a polysaccharide isolated from the green alga, *Cladophora rupestris*, by Percival (Scotland). It was shown to contain L-arabinose, D-galactose, D-xylose, L-rhamnose, and D-glucose in the ratio of 48:38:12:5:3 and was sulfated. This is the first recorded instance of arabinose in an algal polysaccharide. Linberg (Sweden) described the isolation of a disaccharide, mannitol 1-β-D-glucopyranoside, and a trisaccharide, mannitol diglucopyranoside, from several brown algae. Methyl inositol (laminitol) was isolated from several species of brown seaweeds, D-volemitol as a glucoside from *Pelvetia canaliculata*, and a new glycoside, floridoside α-mannoside from *Furcellaria fastigiata*.

Smith, O'Neill, and Perlin (Canada) described the fractionation of preparations of carrageenin from *Chondrus crispus* with potassium chloride and subsequently with ethanol. They established several components, one consisting of D-galactose sulfate as λ-carrageenin, one consisting of this ester combined with 3,6-anhydrogalactose, designated κ-carrageenin, and minor fractions containing glucose, xylose, and L-galactose. The structural configuration of κ- and λ-carrageenins was further clarified by studies of the x-ray diffraction patterns of their fibers by Bayley (Canada). Alginyl stearate has been synthesized by the action of stearyl chloride on alginic acid in pyridine, and the product has been shown to be capable of forming a film suitable for use in the photographic industry by De Keyser (Belgium).

Haxo and O'Chocha (U.S.A.) reported on the cultivation and chemical characteristics of the unicellular red alga, *Porphyridium cruentum*. An extracellular sulfated polysaccharide was isolated which contained glucose, galactose, xylose, and an unidentified uronic acid. The coloring matter of the alga was shown to consist of phycoerythrin, phycocyanins, chlorophyll a, β-carotene, zeaxanthin, and probably lutein.

Two communications dealt with bacterial enzymes capable of hydrolyzing laminarin and alginate (Chesters, England) and agar and carrageenin (Yaphe, Canada). Carrageenase from some marine organisms offers a means of distinguishing between κ- and λ-carrageenins and between agarophytes and carrageenophytes in algal taxonomy. An interesting paper by Liaaen and Sörensen (Norway) dealt with the distribution and interconversion of the carotenoids in *Fucus vesiculosus* and presented evidence for the biological relationship of violaxanthin and zeaxanthin.

More strictly botanical papers were concerned with surveys in different parts of the world and ecological studies. Aleem (Egypt) has explored the habitat of *Macrocystis pyrifera* at La Jolla, Calif., with the aqualung. The production per square meter at different depths has been measured for benthic communities and bottom dwellers. Rate of growth of tagged *Macrocystis* has been measured, and an attempt made to determine the influence of fauna grazing upon it.

Chairmen for the various sessions were F. N. Woodward (Scotland), E. G. Young (Canada), W. Bergmann (U.S.A.), H. Lundin (Sweden), E. Conway (Scotland), D. T. Flood (Ireland), C. G. C. Chesters (England), W. E. Isaac (South Africa), N. Sörensen (Norway), and L. Newton (Wales). It is planned to publish a volume of the proceedings.

E. Gordon Young
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Meeting Notes

■ J. A. Hutcheson, vice president and research director of the Westinghouse Electric Corp., East Pittsburgh, Pa., will be the principal speaker at the opening general session of the fall general meeting of the American Institute of Electrical Engineers that will take place in the Morrison Hotel, Chicago, Ill., on 3 Oct. More than 1000 engineers, scientists, research experts, and engineering executives from many parts of the country are expected to attend the meeting, which ends on 7 Oct. The general chairman is F. A. Cox, an engineering executive with Commonwealth Edison Co.

Fifty sessions on advances, discoveries, and new applications in electrical engineering and the allied arts are planned by the technical program committee, of which Robert M. Bergslien is chairman. These sessions will include x-ray engineering, mining and metal, power generation, transmission and distribution, radio and television, telegraph systems, and a score of other fields. Since the AIEE meeting coincides with the National Electronics Conference, members of both organizations will attend the NEC annual dinner.

■ The Oak Ridge Institute of Nuclear Studies is planning a conference on Rare Earths in Biochemical and Medical Research, to be held in Oak Ridge, Tenn., 27–29 Oct. The conference will stress chemical, pharmacological, and biochemical problems and possible medical applications of the lanthanons and of yttrium. The emphasis on chemical considerations during the first part of the conference is to provide background for succeeding discussions and interpretations of biochemical and pharmacological studies. The last portion of the meeting will include topics that point up possible medical applications of various radioisotopes.

The program of the conference is divided into the following general cate-

gories: (i) chemical considerations, (ii) radioisotopes of special interest, (iii) pharmacological considerations, (iv) biochemical and metabolic considerations, and (v) dosimetric consideration and possible applications. The conference will include both invited and contributed papers by approximately 25 speakers.

■ More than 40 technical papers will be presented at the 25th anniversary meeting of the Society of Exploration Geophysicists, which will take place 3–6 Oct. in Denver, Colo. A wide variety of scientific methods used in exploring for mineral wealth will be discussed, and special attention will be given to uranium and petroleum.

Several speakers, including U.S. Geological Survey specialists, will take part in a full day devoted to mining geophysics, which will be climaxed by the final session of the convention on uranium exploration. Some 1500 delegates from several countries are expected in Denver during the convention week. For information, write to the society at 624 South Cheyenne, Tulsa, Okla.

■ The 3rd Interamerican Congress of Psychology is scheduled for 16–21 Dec. at the University of Texas, Austin. The congress is sponsored by the Interamerican Society of Psychology; the University of Texas and the Hogg Foundation for Mental Hygiene will serve as hosts. Selected delegates from the United States, Canada, and the various Latin American countries will be guests of the congress.

The theme of the meeting will be the "psychology of social tensions," which will be treated from the points of view of applied psychology, mental health, social anthropology, and teaching. There will be four major symposiums, exhibitions, discussions of films, and guided tours.

To apply for participation in the congress, send 5 copies of a 250-word abstract, *deadline 15 Oct.*, to the Program Committee, c/o Werner Wolff, Bard College, Annandale-on-Hudson, N.Y. Registration fee is $10.

Society Elections

■ International Council of Scientific Unions: pres., Lloyd V. Berkner, president of Associated Universities, Inc., which operates the Brookhaven National Laboratory, Upton, N.Y.; retiring president, B. Lindblad (Sweden); sec. general, A. V. Hill (United Kingdom); treas., E. Herbays (Belgium). The vice presidents are K. S. Krishnan (India) and P. Lejay (France). These officers and two other elected representatives constitute the bureau, one of ICSU's three governing bodies; the two new members of the bureau are V. A. Engelhardt (U.S.S.R.) and A. Stoll (Switzerland).

■ Plant Science Seminar: chairman, Raymond W. Vander Wyk, Massachusetts College of Pharmacy; 1st vice chairman, Arthur Schwarting, University of Connecticut; 2nd vice chairman, Harold E. Bailey, Wayne University; sec.-treas., J. Hampton Hoch, Medical College of South Carolina.

Forthcoming Events

October

22–24. American Heart Assoc., 28th annual scientific session, New Orleans, La. (Medical Director, AHA, 44 E. 23 St., New York 10.)

24. American Ethnological Soc., New York, N.Y. (Miss A. G. James, 695 Park Ave., New York 21.)

24–26. National Conf. on Standards, 6th, Washington, D.C. (G. P. Paine, ASA, 70 E. 45 St., New York 17.)

24–28. American Soc. of Civil Engi-

(Continued on page 568)

neers, New York, N.Y. (W. N. Carey, ASCE, 33 W. 39 St., New York 18.)

24–1. International Council for the Exploration of the Sea, annual, Copenhagen, Denmark. (General Secretary of Council, Charlottenlund Castle, Charlottenlund, Denmark.)

25–30. American Ornithologists' Union, Boston, Mass. (H. F. Mayfield, 2557 Portsmouth Ave., Toledo 13, Ohio.)

27–28. New Mexico Acad. of Science, Albuquerque. (C. C. Hoff, Dept. of Biology, Univ. of New Mexico, Albuquerque.)

27–29. American Ceramic Soc., 8th Pacific Coast Regional, Seattle, Wash. (C. S. Pearce, 4055 N. High St., Columbus 14, Ohio.)

27–29. Conf. on Rare Earths in Biochemical and Medical Research, Oak Ridge, Tenn. (G. C. Kyker, Oak Ridge Inst. of Nuclear Studies, P.O. Box 117, Oak Ridge.)

27–29. Electron Microscope Soc. of America, University Park, Pa. (Miss J. R. Cooper, General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio.)

27–29. Gerontological Soc., Baltimore, Md. (N. W. Shock, Baltimore City Hospitals, Baltimore 24.)

27–29. Pharmaceutical Industry: Rensselaer Polytechnic Inst. Industrial Council, 5th annual, Troy, N.Y. (F. Tifft, News Bureau, RPI, Troy.)

28–30. American Soc. for Aesthetics, Chicago, Ill. (J. F. White, Western Reserve Univ., Cleveland 6, Ohio.)

30–1. West Virginia Science Fair Work Conf., Weston. (D. E. Large, Science Fair Program, P.O. Box 117, Oak Ridge, Tenn.)

31–1. East Coast Conf. on Aeronautical and Navigational Electronics of Inst. of Radio Engineers, Baltimore, Md. (G. R. White, Bendix Radio Div., Bendix Aviation Corp., Towson 4, Md.)

31–4. American College of Surgeons, 41st annual clinical cong., Chicago, Ill. (P. R. Hawley, 40 E. Erie St., Chicago.)

31–5. Conf. on Solar Energy, Scientific Basis, Tucson, Ariz. (31–1 Oct.); World Symposium on Applied Solar Energy, Phoenix, Ariz. (1–5 Nov.). (M. L. Kastens, Stanford Research Inst., Stanford, Calif.)

November

1–3. Enzymes: Units of Biological Structure and Function, International Symposium, Detroit, Mich. (C. E. Rupe, Henry Ford Hospital, Detroit 2.)

2–4. American Documentation Inst., annual, Philadelphia, Pa. (S. Rosenborg, Library of Congress, Washington 25.)

2–4. Society of Rheology, annual, New York. (W. R. Willets, Titanium Pigment Corp., 99 Hudson St., New York 13.)

2–4. Symposium on Antibiotics, 3rd annual, Washington, D.C. (H. Welch, Div. of Antibiotics, Food and Drug Admin., U.S. Dept. of Health, Education, and Welfare, Washington 25.)

2–5. American Soc. of Tropical Medicine and Hygiene, Boston, Mass. (J. E. Larsh, Jr., School of Public Health, Univ. of North Carolina, Chapel Hill.)

3. American Federation for Clinical Research, Midwestern, Chicago, Ill. (R. J. Glaser, Barnes Hospital, 600 S. Kingshighway, St. Louis 10, Mo.)

4–5. American College of Anesthesiologists, Boston, Mass. (S. C. Hershey, 235 E. 22 St., New York 10.)

4–5. Central Soc. for Clinical Research, 28th annual, Chicago, Ill. (CSCR, Suite 1215, 25 E. Washington St., Chicago 2.)

4–5. Kentucky Academy of Science, Frankfort, Ky. (Mary E. Wharton, Georgetown College, Georgetown, Ky.)

5. Committee for the Scientific Study of Religion, Cambridge, Mass. (R. V. McCann, Andover Hall, Harvard Univ., Cambridge 38.)

6–7. American Soc. for the Study of Arteriosclerosis, 9th annual, Chicago, Ill. (O. J. Pollak, P.O. Box 228, Dover, Del.)

6–13. International Cong. of Allergology, Rio de Janeiro, Brazil. (F. Alves, Avenida Rio Branco 277, 7° andar, Rio de Janeiro.)

7–9. Assoc. of Military Surgeons of the United States 62nd annual, Washington, D.C. (AMSUS, 1726 Eye St., NW, Washington 6.)

7–9. Eastern Joint Computer Conf., AIEE, IRE, ACM, Boston, Mass. (I. Travis, Burroughs Res. Center, Paoli, Pa.)

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Atlanta, Ga., December 26-31, 1955

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Henry Grady★	5.50–12.00	9.00–12.00	9.50–12.00	16.00–25.00
Imperial	4.00– 5.50	6.00– 6.50	6.50– 7.00	
Jefferson	3.00– 3.50	4.00– 5.00	4.50– 5.00	
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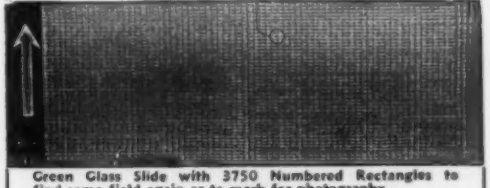

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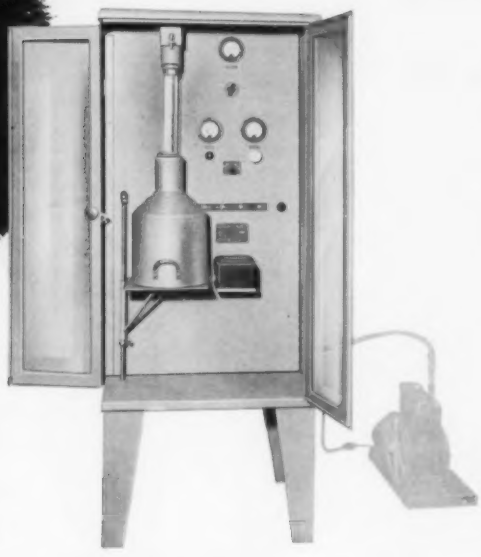

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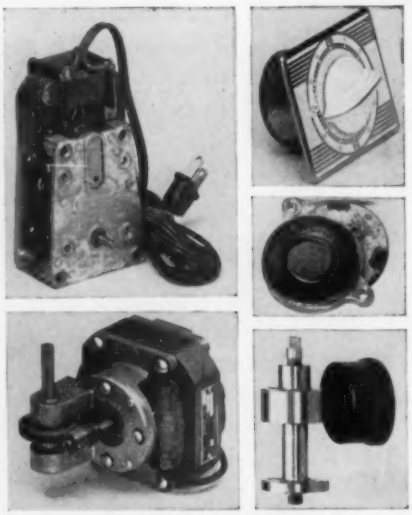

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